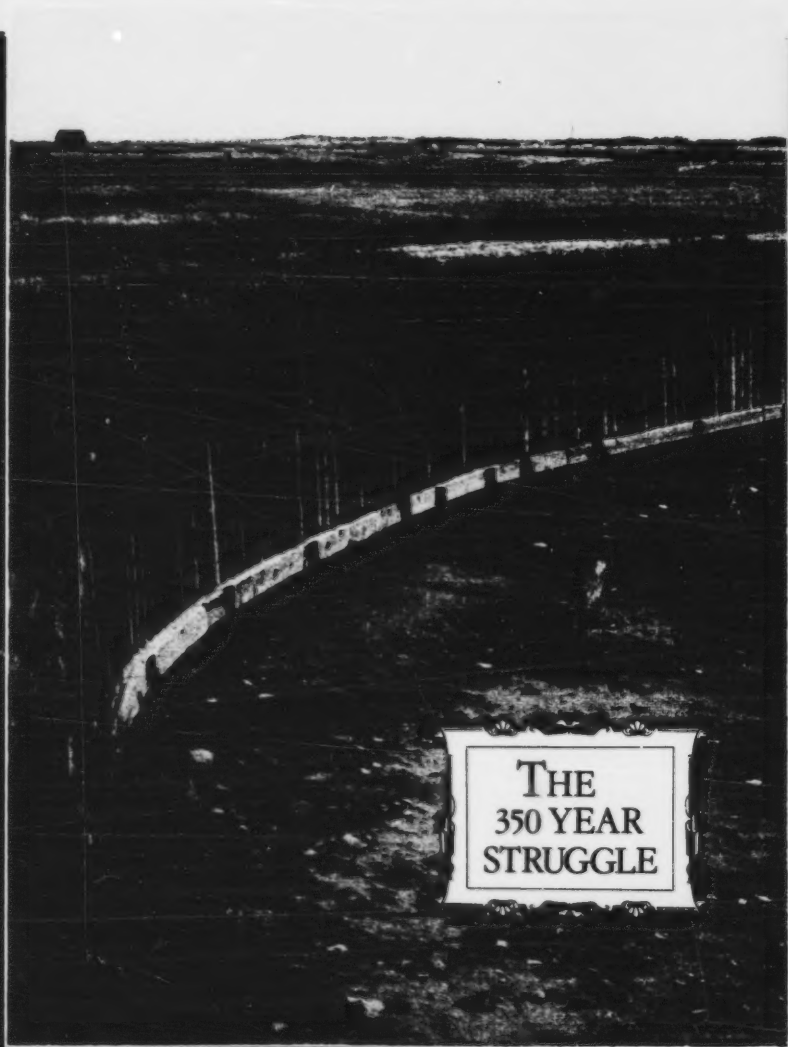


Maritime Dykelands



THE
350 YEAR
STRUGGLE



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Maritime Dykelands

THE 350 YEAR STRUGGLE



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The 350 Year Struggle

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Foreword



he purpose of this book is to record in chronological sequence some of the more significant highlights of the struggle engaged in by people of the Maritime Provinces in wresting land from the sea.

For more than 350 years, beginning shortly after the arrival of the first settlers at Annapolis Royal in 1605, this battle has continued. The process began with little experience, limited manual labor and few material resources. Over the years the struggle progressed, not without failure, to the relatively secure structures such as the Annapolis River and Shepody River dams now in place.

In preparing for publishing a book such as this, it is not feasible to attempt to record in detail all the noteworthy events that took place with respect to dykelands. Nor, unfortunately, is it possible to record the names of so many people who played a prominent part in undertakings to secure these lands for agricultural production.

Beginning at the start of the seventeenth century, the development of dykelands was closely tied to the history of the Maritime Provinces. In fact, the first early settlement spread to areas where land that could be dyked was located.

This history, as initially prepared by writer Eric Hustvedt, was commissioned jointly by the Nova Scotia Department of Agriculture and Marketing and the New Brunswick Department of Agriculture and Rural Development. It is supplemented by drawings, charts and photographs from various sources. It is hoped that it will serve as a reminder to all who read it of the resourcefulness and determination of those who participated in the battle to gain land from the sea.

In this book the word 'dykeland' is used to describe land protected from the sea by dykes. However, on the New Brunswick side of the Bay of Fundy 'marsh' includes both dyked and undyked saltmarsh.

A 'marsh body' is a natural unit of saltmarsh, much of it dyked, whose owners, until recent decades, organized to build and maintain dykes, main drainage ditches and other common works. 'Marsh body' has meant either the land itself or all of its owners as in 'Aulac Marsh Body'.

In Kings County, Nova Scotia (and perhaps in other places) the area of saltmarsh protected by dykes is itself called a dyke, as in the 'Wellington Dyke'. In that county, the structure which protects the dyked area is called a 'running dyke'.

D.C. Milligan

Introduction



he history of the dykelands of the Maritime Provinces of Canada is as rich and deep as the fertile red soil that sustains them.

First came tremendous tides, surging up the Bay of Fundy, spreading layer upon layer of silt over the shores of its sprawling estuaries and along the river banks. Over thousands of years, the tides built sediment to depths of more than 40 meters. On the surface, vast rippling mudflats stretched from low-tide line toward the upland, turning to saltmarsh where the high tides reached.

Then came the dykeland culture of the Acadians. In the 1630s a small band of French settlers dyked and drained a few acres of saltmarsh at Port Royal (present-day Annapolis Royal, Nova Scotia) and discovered that the new dykeland could produce abundant crops year after year without help of fertilizer. Farmland that could produce two tons of hay or 50 bushels of wheat in a season soon became the means of providing most of the colonists' food and clothing and allowed a distinct Acadian society to prosper and grow.

To harvest the wealth of the tidal soil, the Acadians learned to work between the tides in the slippery marsh mud. They built earthen, sod covered dykes just tall enough (about 1.5 m) to keep out high water. To drain the dyked marsh, they invented the *aboiteau*, a log sluice with a hinged gate inside it. The gate would open to let the fresh water out when the tide was low but close against the tide coming in. An *aboiteau* would be placed in a creek bed and covered with layers of brush and earth until the channel was blocked to an elevation above the level of the highest tides.

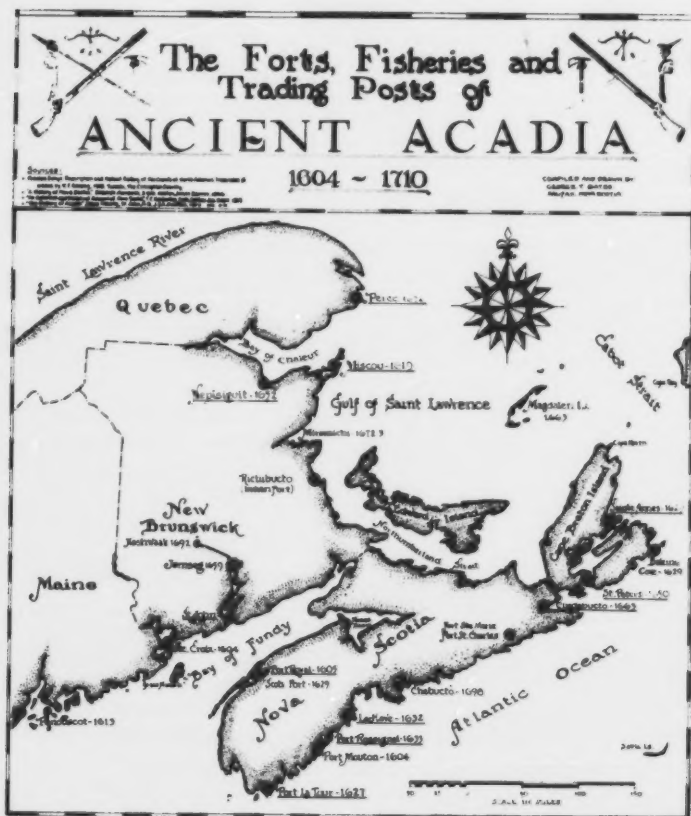


Figure 1

Beginning close to the upland, the Acadians created a few acres of farmland at a time, extending the dyked land slowly toward the outer edge of the saltmarsh.

The dykelands supplied the basic needs of the Acadians so well that they largely avoided clearing the upland. In fact, when all available marsh had been dyked along the Annapolis River, the colony expanded to other marsh areas around the Bay rather than using available upland nearby.

The New Englanders who settled on the vacant Acadian homesteads after the Expulsion were upland farmers unfamiliar with dykeland agriculture. They arrived to find dykelands flooded with saltwater by a severe storm in 1759 which had badly damaged dykes and aboiteaux.

To survive the first years the new immigrants had to rely on the dykeland skills of Acadians who had been confined to English forts. Yet they soon learned how to use a dyking spade and patch a sea wall.

Although they turned to clearing the upland for many of their crops, the New Englanders always valued dykeland for hay and pasture, and used marsh mud as an upland fertilizer. In fact dykeland would sell for the highest per acre prices.

Over the next two decades came Germans, Yorkshiremen and a huge influx of Loyalists. By the early 1800s these immigrants and their descendants had not only recovered most of the tidal land once protected by the Acadians but had begun to create new dykeland, sometimes on a large scale.

Marsh owners in the Canard, Nova Scotia, area reclaimed 214 hectares (528 acres) of new farmland in one piece when they completed the Wellington Dyke in 1825 after eight years' work. The Etter Aboiteau, finished in 1840, protected hundreds of hectares of tidal land along the Aulac River from the tides of the Cumberland Basin. All owners of a marsh body, a unit of land naturally covered by saltmarsh, shared the costs of dyke-building and maintenance by contributing labour, money or materials.

During the nineteenth century, as horses became the main source of power for the region's prosperous mining and logging operations and for most land transportation, hay became an increasingly lucrative cash crop. By the early 1900s, there were markets for Fundy hay as far away as Boston. In 1921, prices had reached more than \$25.00/acre). Where large tracts of dykeland could be devoted to hay, as in the Tantramar Marshes or at Minudie, some owners made small fortunes.



Figure 2 This drawing shows the relative heights of high tides at various general locations in the Bay of Fundy. (Source: MRMS)

But the bubble burst during the 1920s as fossil-fuel engines replaced horsepower as North America's main source of energy. The price of hay fell to \$6.00/ton by 1938 and the value of dykeland slid to \$65.00/hectare by the 1940s. Many hay fields brought into production for the boom were abandoned, leaving the burden of maintaining dykes and aboiteau to the dykeland owners on each marsh body who wanted to continue working the land. Sometimes the job was beyond their resources.

By the late 1930s all dykeland areas — even those where the owners had not concentrated on exporting hay — were suffering from the effects of the world-wide depression. Drainage ditches clogged up, dykes leaked and aboiteaux sagged. On some marsh bodies the protective works failed completely, sending acres of long-dyked soil back 'out to sea'. Thousands more hectares of the region's best farmland threatened to disappear.

The crisis was too serious for dykeland owners to handle alone. In 1943, the Experimental Farms branch of the Federal Department of Agriculture set up an emergency program to meet the situation. The cost of dykeland repairs in New Brunswick and Nova Scotia would be shared equally by the owners, their provincial governments and the Federal Government. A two-man staff would arrange and oversee all the work in both provinces.

With this three-way program "came the first wide use of modern machinery in dykeland construction." Although long thought too heavy for slippery marsh mud, bull-dozers and draglines did the bulk of the work on several major projects. Even with the help of this break-through, however, it became obvious that the scope of the emergency program was too small. Dykes and aboteaux were failing faster than the owners and the program's tiny staff could patch them up, and only a massive reconstruction effort would save the day.

In 1948 the Federal Government created the Maritime Marshland Rehabilitation Act to mount a comprehensive long-term program for preserving the region's dykelands. Under the Act the Federal Government would build and maintain dykes and aboteaux, and the three Maritime provinces would provide liaison with landowners to look after the main drains and promote land-use programs.

Based in Amherst, Nova Scotia, the 70-member staff of the Maritime Marshland Rehabilitation Administration (MMRA), began applying modern engineering techniques to the traditional problems of dykeland construction and maintenance. Draglines and steam shovels replaced dyking spades and draft animals altogether. Over the next 20 years, the MMRA ensured the protection of 18,000 hectares (44,500 acres) of tidal farmland in Nova Scotia and 15,000 hectares (37,300 acres) in New Brunswick, building 373 kilometers (232 miles) of dyke in the process.

A major accomplishment of the Administration was the construction of large tidal dams near the mouths of the Shepody, Annapolis, Avon, Tantramar, Petitcodiac and Memramcook rivers, all bounded by saltmarsh and dykeland. These giant concrete and steel aboteaux now keep the tides off all lands upstream and eliminate the need for many kilometers of dyke and many smaller aboteaux.

In 1970 the individual provinces took over all government responsibilities for the dykelands. Since then one of the major aims of the Nova Scotia and New Brunswick governments has been to increase the amount of dykeland that can be farmed with modern machinery. Small holdings have been assembled into larger, more efficient units and through a drainage technique known as 'landforming', networks of deep, narrow ditches have been replaced by wide, grassy waterways.

Today the total area of 33,000 hectares (82,000 acres) of tidal land protected from saltwater supports the production of hay, dairy products, beef, hogs, some grain and a small but growing amount of vegetables.

Surprisingly, much dykeland soil now lies out of production. The market for many of its products is already saturated. However, the situation may be temporary. An increase in transportation costs (making imported foods more expensive), and an increase in the region's population due to offshore oil development — or other factors — could bring all the available dykeland into production.

Some dykeland owners are not waiting for change, but are testing the market for such produce as canning peas, beans and corn as well as other specialty crops.

Dykeland has been called a reserve of energy in the form of fertility. As the cost of fertilizers needed for upland farming continues to rise, the value of the same nutrients in dykeland soil increases as well. In the future, some farm operators may increase their efficiency by moving the site of some of their production from upland to dykeland.

The advantages of the tidal lands around the Bay of Fundy are certainly no secret to the agricultural community. Recent sales of dykeland for as much as \$2,500/hectares (\$1,000.00/acre) indicate a growing appreciation of the region's most fertile soil.

Chapter I

A Gift of the Tides



he region's most fertile soil owes its breadth to the highest tides in the world, its depth to a sinking coastline and its availability to the clever industry of man.

The average range between high and low tide at the upper reaches of the Bay of Fundy is about 12 meters (compared to 1.4 meters at Halifax and 2.7 meters at Boston). Every 12½ hours the tide surges up the Bay, scouring shale and sandstone from its floor and walls. Before there were dykes, the tide spread these particles as rich red mud over vast areas of low-lying coast. The highest tides could rise as much as 16 meters up its rivers, spilling muddy saltwater over river banks and onto valley floors.

Then as now the fast-moving tide would carry its heavy load of sediment in the form of clay, sand and silt particles until the current came to rest. Then the particles would drop out of the water and stay behind as the tide went gently out. On undyked marsh at the upper reaches of the Bay, a single tide can still leave a layer of sediment of 2-3 centimeters thick.

The high tides and their silting action are quite new to the Bay in geological time. At the end of the last ice age, about 6,000 years ago, water levels were so low that George's Bank was an island and the opening to the Gulf of Maine (between George's Bank and Brown's Bank) was less than 100 kilometers wide.

As the ice melted, water levels raised toward present elevations and the incoming tides began to rush further up the long funnel-shaped Bay of Fundy. At the same time, the rhythm of the tide cycle in the Gulf of Maine and the Bay

happened to evolve in step with the rhythm of the tide cycle in the Atlantic Ocean. Their waters rock back and forth in concert. For this reason, the Gulf is described in oceanography as an oscillating basin.

The combination of the shape of the Bay of Fundy and the development of the oscillating basin led to the evolution of the highest tides in the world.

† The Sinking Coastline

The Bay of Fundy tides are not steady and uniform. Their heights not only vary as governed by weather conditions but also vary daily, monthly, seasonally and yearly by influences, some of which are not entirely understood. However, every tide in the Bay begins with a great rush of water that has an extremely erosive effect on the bottom and shoreline of the area. These rushing waters have the power to loosen and transport large volumes of soil particles. As the tidal waters reach their maximum heights and spread over mud flats and stream estuaries their velocities decrease and their soil-transporting powers diminish. Thus the silt in the tidal waters is deposited in thin layers over the areas which they cover.

For the past several thousand years the elevation of land in relation to the sea has been changing around the shoreline of the Bay of Fundy. This change has resulted in the sea-water elevations becoming higher in relation to the land, causing the tides to infiltrate further into stream estuaries and to cover more of the shoreline. Whether this phenomenon is caused by the land sinking or the water rising or a combination of both is open to speculation. However, the rate of change is about 40 cm/century.¹ As a result, each layer of tidal sediment eventually is covered by a new layer with the deposition proceeding further and further inshore. Over many thousands of years the process has created an extensive deep soil deposit laden with plant nutrients.

The Bay of Fundy marshland soils are technically known as Acadian Soils. The mixture of silt, sand, clay and water presented by these soils, after the salt has been leached out, is very productive for the growth of crops, particularly grass crops. Consequently some dykeland areas, utilizing the vast store of nutrients available, have produced good yields of hay continuously for more than two hundred years without the aid of fertilizer.²

Tillable, upland soils around the Bay of Fundy contain significant quantities of plant nutrients only in the top 15 to 30 cm. Below that level practically all of the plant food has

been leached out due to the extensive precipitation in the region. A recent comparison of nutrients in the top 75 cm of dykeland and upland soil showed dykeland with six times as much potassium, two and one half times as much phosphorous, three and one half times as much calcium and four times as much magnesium as the upland sample.³

Good productivity of the dykeland soils was soon apparent to the first European settlers in the region. Consequently, settlement around the Bay of Fundy spread out from its beginning at Annapolis to areas where dykeland was available.

TABLE I

Physical Analysis of Two Marsh Profiles (After Aalund) ¹

	Depth	Sand	Fine Sand Total	Clay	Under
		1.0-0.05	0.05-0.005	0.005	0.002
		mm	mm	mm	mm
	cm	%	%	%	%
PROFILE 1	0-15	12.7	53.4	34.0	28.8
	15-30	4.0	44.1	51.9	45.1
PROFILE 2	0-15	12.6	51.8	35.6	30.1
	15-30	18.1	60.4	21.5	17.8

Chemical Analysis of These Profiles (After Aalund) ¹

	Depth	Moisture Loss on Content Ignition		pH	N ₂	P ₂ O ₅
		%	%	%	%	%
	cm	%	%	%	%	%
PROFILE 1	0-15	2.24	6.35	5.0	0.173	0.112
	15-30	2.97	5.05	5.6	0.104	0.172
PROFILE 2	0-15	2.28	6.7	5.7	0.196	0.137
	15-30	1.37	3.1	7.3	0.063	0.110
	Depth	K ₂ O	SiO ₂	R ₂ O ₃	CaO	
		%	%	%	% %	
	cm	%	%	%	% %	
PROFILE 1	0-15	2.329	66.10	18.90	0.845	
	15-30	2.313	62.16	24.97	0.673	
PROFILE 2	0-15	1.996	65.99	22.18	0.831	
	15-30	2.253	72.02	17.80	0.867	

Source: *Soil Survey Report of Southeastern New Brunswick*, Fredericton (1950)



Chapter II

The Seeds of a Dykeland Culture



July, 1636

The *Saint Jeban* clears the dock at La Rochelle, France, and sets course for the New World. On board are several tenant farmers from the wet lowlands of nearby Upper Poitou, bringing their families across the ocean in the hope that Acadia, and their own hard work, will someday provide them a place of their own. The ship also carries five *sauniers* or 'salters' from the shore of La Rochelle itself, men who make a living trapping salt from the high tide.

On deck two passengers watch the coastline move slowly away.

"It will be a long time before I see France again," says Louis, a big, bearded salter, to no one in particular.

"For me," says the other man solemnly, "it will be never." Jean is a farmer, short and wiry.

"Don't count on it," says Louis, still looking to shore, "The English burned Port Royal to the ground 20 years ago. . . a ship from Virginia. . . Who's to say it won't happen again? Don't forget: they're just as interested in the fur trade as we are. We should just be thankful we get along so well with the native people."

Jean thinks this over. "But Port Royal was just a little outpost. There are real settlers in Acadia now — farmers and their families at LaHéve. When our families join them, Acadia will soon grow into a proper colony, easier to support and defend."

"Well, from what I hear," says Louis, looking away from the sea and frowning at the shorter man, "they could use the help. It took them three years to produce a grain crop."



Figure 3 Map of France at the time of the first settlers came to Annapolis. (Drawing courtesy of MRMS)

Jean is startled. "But . . . but they are all hard-working people. Why, my cousin Marcel . . ."

"Oh, they're working hard all right," says Louis, "but they never had to clear a forest before. The farmlands of Poitou, Touraine and Anjou have been cleared for centuries. Acadia's ocean shore is not only a tangle of bush, but full of rocks and boulders as well."

Jean turns to him abruptly. "How can you know these things?" he demands.

Louis waves his hand lazily toward the shore. "I work by the sea. Ships come and go. But I should not be so hard on your dreams, my friend. When we salters arrive, things will soon improve. You see, I also know we are not going to LaHéve but to Port Royal, where large tracts of saltmarsh lie barren of rocks and trees."

Jean is only slightly reassured. "Too wet and salty."

"Of course it is! But if you build dykes to keep out the tide, rain will rinse out the salt. In a couple of years you have some land ready to work. Dutch engineers have been showing farmers around La Rochelle how to do this for several years now. The trouble is your cousin and the others don't know much about dyking."

"So you fellows are going to show us?"

"At your service," says Louis, bowing grandly. "Of course we build dykes to keep the water in, not out, so we probably have a few tricks to learn. Nothing we can't handle." Then, after a pause. "But one thing bothers me a little. None of us have much experience with drainage. After all, we simply let our 'salt pans' dry out."

To Louis' surprise, Jean suddenly begins to laugh. "But that's exactly what my cousin and I and all the other lowland farmers know something about. The wet land of Poitou wouldn't be very useful if we didn't keep it well drained. From the time we are boys we are busy digging and clearing ditches."

"Well, then," says Louis, slapping his new friend on the back, "we will all work together. Acadia will be a prosperous colony indeed!"

As the two shake hands, France shrinks to a thin ribbon on the horizon, then quickly disappears.



Chapter III

Setting the Stage



griculture had several false starts on the Bay of Fundy before dykeland farming began in the 1630s or 1640s.

The first large wave of Europeans into the region came looking not for farmland but for cod. In the sixteenth century English, Breton, Norman, Basque, Spanish and Portuguese fishermen sailed the coasts of Newfoundland and Nova Scotia. Discovery of the offshore banks as a rich harvesting ground increased the traffic. Many fishermen would stay for a season, then cure their catch on shore before returning home. Along the Nova Scotia coast the practice led to a trade in furs with the native Micracs.

† The First Port Royal

The abundant furs quickly joined the teeming fish stocks as a profitable attraction for Europeans. In 1605, one Sieur de Monts, who had been granted a monopoly on the region's fur trade, established a post at Port Royal (which is the present-day Annapolis Basin) 10 kilometers west of today's town of Annapolis Royal. The expedition, which had already lost half of its all-male band to scurvy on tiny Ile St. Croix (Dochet's Island, Maine) the previous winter, arrived with about 40 survivors.

During the two-year life of the tiny Port Royal settlement the adventurers survived largely on fishing, hunting and gathering shellfish. However, they also experimented with European crops, and raised hogs and sheep.

Lescarbot, a lawyer who lived at the post, writes of "sowing wheat, rye, barley, oats, beans, and garden plants,"¹ and



Figure 4 General location of marsh areas along the Bay of Fundy

reports that "The rye is as tall as the tallest man."² However, dykeland was surely not involved. There are no mudflats near the site of their *habitation* and Lescarbot mentions nothing of dykes. The trappers probably created their farmland out of nearby forest with axe, spade and hoe.³ They also may have planted crops on the present town site.⁴ The successful harvests proved that familiar crops could grow in the cool, wet climate.

The ambitious first Port Royal settlement even built a water-powered grist mill in 1607. Unfortunately de Monts lost his fur-trading monopoly, through political changes in France, before that year's harvest. Since the purpose of agriculture was to support the trading operation and not to lay the foundation for a permanent colony, the settlement was completely abandoned.

† Two More False Starts

There would be two or more short-lived colonies at Port Royal before the days of the *Saint Jéban*.

In 1610 a member of the de Monts' party tried to revive the original outpost. His band succeeded in carrying on a fur trade until the settlement was razed by an English privateer from Virginia in 1613. There were no women or children at the outpost and the settlement never stopped looking for help from France for much of their food and most of their material needs.

About 1628, the Scottish nobleman Sir William Alexander, who had been given title to 'Nova Scotia' by the British, set up a colony near the de Monts' site. There may have been as many as 100 settlers, including perhaps two or three women. However, the settlement never established an agricultural base and relied on annual supply ships from Europe. One year the vessel arrived to find 30 colonists had died since the last visit. During the life of the Scottish colony, some settlers may have left for the Atlantic coast fisheries or for New England.⁵ The Alexander experiment came to an end with the treaty of 1632 which established French control over the region.

† Acadia Begins

Permanent settlement on the Bay of Fundy, or La Baye Française, had its roots on the south shore of the Nova Scotia peninsula later that same year. Isaac de Razilly arrived at LaHéve (present-day LaHave at the mouth of the LaHave River) to establish a colony supported by a mixture of fur-trading, fishing and farming.

Razilly brought 300 people with him. Many — perhaps most — were tradesmen and labourers who left after the colony was established. There may have been 100 settlers living at LaHéve by 1635.⁶ Family units probably made up a healthy minority of the population, providing a kind of stability that was for the most part completely absent in the earlier settlements at Port Royal or at the tiny French fur-trading outposts and fishing stations sprinkled around Acadia.⁷

By 1635, the LaHéve settlers had built cabins on each of 40 assigned lots and cleared the rough terrain enough to cut at least one wheat harvest.⁸ Razilly died that year, however, and control of the colony fell to his lieutenant, Charles de Menou d'Aulnay. Perhaps for advantages in the fur trade, the new leader began to move most of the colony to Port Royal on the site of the present town of Annapolis Royal.⁹ D'Aulnay continued Razilly's balanced approach to settlement by importing the farm families from southwestern France on the *Saint Jehan*.

Chapter IV

A Dykeland Culture

There is a great extent of meadows which the sea used to cover, and which the Sieur d'Aulnay had drained. It bears new fine and good wheat. . . *Nicholas Denys describing the Port Royal of the 1650s.*



dyking began in the early years of d'Aulnay's Port Royal. The native Micmacs lived a nomadic hunting life, coming to the coast only in the warmer weather to fish or hunt seals. And there is no evidence of dyking in any of the previous European settlements on the Basin.

There is no evidence of dyking having taken place prior to d'Aulnay's Port Royal. The first dykes were therefore probably built between 1635 and 1640.

According to one theory, d'Aulnay brought out the six *sauniers* aboard the *Saint Jehan* to work for him at their usual trade. In this way he could meet the high demand for salt among the region's fishermen at a price that did not include the very high tax on French salt. According to this version, the business did not work out, but the salters, who knew about the dyked marshes around La Rochelle, suggested the settlers could create better farmland through dyking the saltmarsh than by clearing the upland.¹

On the other hand, d'Aulnay may have known something of dyking to create farmland. Dutch engineers were bringing dyke-building techniques to various parts of France (including La Rochelle, presumably) during this period.²

In any case, d'Aulnay and his settlers could watch every new tide wash in over the mudflats along the shores of the River Dauphin (Annapolis River) and flood the banks of its nearby tributary, the Allain River. At low tide they could see the tall, stiff 'cord grass' leading the march of vegetation out into the mudflats.



Figure 5 1. *Spartina alterniflora* Lisel. Erect Marsh-Grass
2. *Spartina patens* (Alt.) Muhl. Spreading Marsh-Grass

Although cord grass (*Spartina alterniflora*) may be covered by saltwater almost half the time, it can survive — and even thrive — because it can hold rainwater much like a desert plant and has hollow inner passages for channelling air to a tough root system.

Along the areas covered only by the highest tides, which occurred only a few times per month, the colonists could see the cord grass give way mainly to a low sprawling marsh grass joined by 'black grass', marsh sedge and glasswort. On the loamier upper parts of the saltmarsh grew spurrey, 'goose tongues' and seaside golden rod.

In the first months or perhaps years after the *Saint Jehan* reached Port Royal, the colony built its first dyke around a few hectares of marsh near the upland. Made with an earth core and covered with saltmarsh sods it was just high enough to keep out normal high tides. Drainage ditches were dug along the paths of natural run-off to a site where the drainage water could be vented into the Bay or tidal creek.

In six to eight years, rain and snow melt leached salt from the soil and the vegetation turned from sedges to upland grasses. Gradually saltmarsh became firm, dry dykeland ready for tillage and planting. The first trials produced such good crops that dyking quickly became an accepted farming practice.

Dykeland farming, in turn, caused such a break with European traditions that the second generation of settlers at Port Royal no longer thought of themselves as French but as Acadian, a unique and separate ethnic group.

The major Acadian dykeland crops were hay, wheat and peas, but oats, barley, and corn, beets, carrots, parsnips, onions, chives, salad greens, cabbage and turnips, flax and hemp for spinning and weaving, and a wide variety of herbs were also produced.

In the cycle of the farming year

the dyked marshes were ploughed in the fall when relatively dry. This enabled the farmer to sow his seed several weeks earlier in the spring. The ploughed ground was broken up and smoothed with a harrow as soon as the weather permitted in the spring. The grain or grass seed was sown by hand.⁴

The Acadians harvested *English bay* (timothy, clover, etc.) in July or August; grain in late August or September; and the cord grass on the undyked marsh in late fall for use as a winter 'salt hay' fodder.

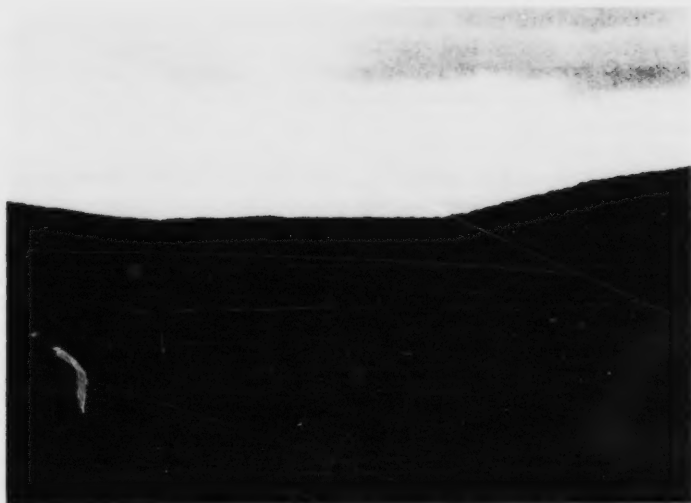


Figure 6 Hay straddles, on which slat bay was piled at the time of harvest, then moved to the farmstead during the winter months.



Figure 7 A bay straddle loaded with saltmarsh bay at Eelbrook, Yarmouth County, Nova Scotia.

A testimony to the fertility of dykeland soil is the fact that the Acadians never used manure, or any other fertilizer, on the reclaimed marshes. In fact, manure became piled so high beside their barns that occasionally the buildings had to be moved to a new spot.⁵ Dykeland was pasture for cattle and sheep, while swine were kept to the forest.

Although they earned most of their food and clothing from the produce of the dykelands, the Acadians supplemented the harvest with hunting and fishing. Their hardware and luxuries came from trade with New England sailing merchants.

By 1670, the Port Royal colony had grown to 350 people and stretched out along both sides of the River Dauphin from about three miles below the present town of Annapolis Royal to about 15 miles above it.

A few non-farming families were located at the fort on the present town peninsula, but the main job of most of the people most of the time was agriculture. The French census of 1671 lists 400 arpents (about 140 hectares) of cultivated land, 652 cattle and 430 sheep (which were kept for wool and rarely eaten). Nearly all the cultivated land was dykeland, for the Acadians cleared very little upland — a fact that frustrated several French observers in later years.

The shape of their settlement was dictated by their dykeland agriculture. To protect and maintain their reclaimed farmland, the Acadians broke with the French tradition of villages and towns clustered around a church and a town square. To be close by should any leaks or breaks begin in the drywall, the Acadians settled in a string of farms on the edge of the upland overlooking their dykeland.

Each farmstead, consisting of a family or two, maintained its own stretch of reclaimed marsh, though men from several families would get together to build a dyke or an *aboiteau*.

Decisions about dykes were likely made by the oldest resident, male or female, at each location.⁶ In fact, the Acadians became quite free to make most local decisions when the British captured Port Royal and several small French outposts in 1654, controlling the region until Acadia was returned to France by a treaty in 1667. The British were primarily interested in protecting their fur trade and discouraging raids on New England directed from Quebec. They made little attempt to govern the Acadians.

Following the British occupation, the Acadians expanded their dykeland culture to other saltmarsh areas of the Bay. By 1707 the population of the settlements was about 1800, with less than a third of the total at Port Royal.

The first new dykeland community was Beaubassin, which sprang up along the shores of the Cumberland Basin between present-day Sackville, New Brunswick and Amherst, Nova Scotia.

Jacques Bourgeois, a Port Royal surgeon and farmer, had seen on fur-trading expeditions the thousands of acres of dykeable marsh at the head of the Bay. In 1671 he led five families to settle on the east bank of the Missaguash River. Within five years Beaubassin had become a successful agricultural and fur-trading community. By 1707 there were nearly 300 settlers on 40 farms.

A visitor to Beaubassin in the 1680s described the surrounding land as able to support 100,000 cattle, though he thought the dependence on livestock by the Acadians living there meant that field crops did not get enough attention.⁷

In 1698 a Port Royal miller named Pierre Thibaudeau and a Blanchard family founded a settlement near the mouth of the Shepody River. By 1707 this community plus one somewhere on the Petitcodiac River had a total population of 55.

Around 1682 Pierre Melanson settled at Grand Pré and Pierre Terriau established himself on Riviere St. Antoine (Cornwallis River). Both had been leading members of the Port Royal community. By 1688 there were 30 families in the area and close to 100 acres of marsh had probably been dyked. Most of the settlers were young, and eager to come to a place more remote from English raids and French authority than Port Royal.⁸

The Minas settlement spilled over into the present-day Windsor-Falmouth-Hantsport area, which came to be called Pisiquid. By 1707 the total population around the Avon estuary was about 600.

The last area of dykeable saltmarsh settled by the Acadians during their years of expansion was at the head of the Minas Basin around present-day Truro, Nova Scotia. Established in 1688 by one Mathieu Martin, the community came to be known as Cobequid. Nearly 100 people lived there in 1707.

Throughout the last part of the seventeenth century, the Acadians continued to build dykes in the traditional way. However, with the appearance of sawmills, sluices could be made of squared timbers.

They also continued to pay little attention to upland, a fact that annoyed several French visitors. Typical was Saccardy, an engineer who visited Port Royal in 1689. He proclaimed that most crops should be planted on the upland, leaving dykeland free for hay alone. And he worried that Acadian agriculture

promoted laziness in children because they were spared the job of hauling and spreading manure. Clearing and working the upland soil, he said, would teach them the value of hard work.

Another common complaint was the risk of dyke failure, which would put flooded lands out of production for at least two years.

Even so, at least one observer, the *Sieur de Dierville*, who visited Port Royal in 1699, saw some good reasons for the Acadian approach, reporting that

those Uplands, which must be cleared in the forest are not good, and the seed does not come up well in them; it makes no difference how much trouble is taken to bring them in condition with manure, which is very scarce; there is almost no harvest, and sometimes they have to be abandoned.

In 1710 a British sailing force under Francis Nicholson captured Port Royal, bringing an end to French control on the south side of the Bay of Fundy. However, the Acadians did not leave and there was no rush of English immigrants. Even by 1740 there were only two or three English families in the Bay area living near the British garrison at Annapolis Royal (as Port Royal had been renamed).

The British were faced with governing a prosperous dykeland people whose language, traditions and religion were associated with France and whose population continued to double every 10 years.

When the French-English struggle for the region grew into war in 1744, the Acadians tried to stay out of it. The senior British official wrote that Annapolis Royal was able to resist a French attack largely because of "the honest neutrality" of the great majority of Acadians.⁹

But events were closing in on the nation of dykeland farmers. In 1749 the English established Halifax as a fort and large settlement to counteract the French fort Louisbourg that had been built on Isle Royale (Cape Breton Island) in 1713. The English also built Fort Edward at Pisiquid and a blockhouse at Grand Pré. In 1750 a French-English border was drawn right through the Chignecto settlements when the British built Fort Lawrence on the west side of the Missaguash River and the French erected Fort Beauséjour on the east side.

Ironically both French and English forts added to Acadian prosperity by providing a market for surplus produce. At the same time the ability of Acadian farmers to supply the British forces helped delay the deportation of the Acadians for several

decades. Until the 1750s the British simply had no other source of food.

By 1750 the number of Acadians around the Bay had climbed to about 10,000. Most of the expansion was up the Memramcook and Petitcodiac rivers in the area claimed by France. The estimated population and distribution of Acadian settlements of the time are shown in Tables 2, 3, 4 and 5. Table 6 shows the accomplishments of Acadian agriculture just before distant forces separated the region's first dykebuilders from their dykelands.

TABLE 2

Estimated Population of the Chignecto Area in 1750

Cumberland Basin east of the Missaguash		850
Minudie peninsula	175	
Hebert River	125	
Maccan River	75	
Nappan River	150	
La Planche River (east)	50	
Beaubassin (Missaguash to La Planche)	275	
Cumberland Basin west of the Missaguash		650
Beaubassin (Ft. Beaséjour Ridge)	225	
Aulac and La Coupe	150	
Tantramar	150	
Pré des Bourgs	25	
Pré des Richards	75	
Baie Verte	25	
Cumberland Basin, scattered		100
Total		1,600
Shepody Basin		1,200
Memramcook	300	
Petitcodiac	400	
Shepody	500	

Source: *To a considerable extent these figures are based on various estimates of the source of refugees or number of old residents in the 1750-55 period. See AC, G1-166, 267-91, especially, and Chapter 8.*

TABLE 3

Estimated Population of Minas District in 1750

Pereau Creek	50
Habitant Creek (Rivière de la Vieille Habitation, or des Vieux Habitants)	75
Canard	750
Upriver, around Dyke Village	350
Downriver, along both banks	150
Canard-Cornwallis interfluve	250
Cornwallis River (Rivière de Habitants)	100
Grand Pré	1,350
Gaspereau	125
TOTAL	2,450

Source: *Author's estimate based on (Charles Morris). A Brief Survey of Nova Scotia (n.d.), Cap. 5, p. 10.*

TABLE 4

Estimated Population of Pisiquid in 1750

Left bank (present Hantsport-Falmouth area)	800
St. Croix River and present Windsor area	500
Kennetcook River and right bank generally	100
TOTAL	1,400

Source: *Author's estimate based on Charles Morris, Judge Morris' Remarks Concerning the Removal of the Acadians, Nova Scotia Historical Society Collections (1881), p. 159.*

TABLE 5

Estimated Population of the Cobequid Area in 1748

Tennycap (Petite Rivière?)	25
Noel (Ville Noel or "Nela" Noel)	50
Maitland (Ville Rovert?)	25
Elsewhere west of Shubenacadie	25
Shubenacadie up to Stewiacke	100
South side, Shubenacadie to present Truro	180
(Villes Percé, Burke [Bourcq] Michael Oguin, Jean Doucet, etc.)	
North side, east of Chiganois River (North River, Onslow, etc.)	120
Chiganois River and Lower Onslow (Ingonish)	100
Masstown (Cove of Cape d'Eglise)	100
Debert (Ville Burke) to Point Economy	75
Point Economy	30
Five Islands	30
Five Islands to Cape D'Or	40
TOTAL	900

Source: Author's estimate based on F.H. Paterson, *Old Cobequid and its Destruction* (1939), and Charles Morris, *Judge Morris' Remarks Concerning the Removal of the Acadians*, Nova Scotia Historical Society Collections (1881), p. 159.

TABLE 6

Agricultural Activity in 1750s

Location	Cattle	Sheep	Swine	Horses	Dyked Land	
					Acres	Hectares
Annapolis	3,000	6,000	3,000	350	3,000	1 200
Minas Proper	5,000	9,000	4,000	500	4,000	1 600
Pisiquid & Cobequid	2,500	3,500	1,500	200	2,500	1 000
Chignecto	7,000	8,000	4,000	500	3,000	1 200
Outlying settlements	250	150	250	50	100	40
TOTAL	17,750	26,650	12,750	1,600	12,600	5 040

Source: Author's estimate based on *Journal of Colonel John Winslow, of the Provincial Troops, while Engaged in Removing the Acadian French Inhabitants from Grand Pré. . . 1755*, Nova Scotia Historical Society Collections (1885), p. 122.

By 1755 the Acadians had not agreed to take an unqualified oath of loyalty to the British Crown. (They had taken an oath in 1726 that did not require them to bear arms, excusing them from fighting the French or Indians.) More than 2,000 British settlers lived at Halifax, while 1,000 Protestant Germans, Swiss, and French had settled at Lunenburg. In that year British forces began to round up the great bulk of the population in the dykeland farm communities of Annapolis, Minas, Pisiquid and Cobequid and, later they captured Fort Beauséjour — the Chignecto settlement as well — burning houses, barns and fields in their wake.

The uprooted Acadians were sent to the American colonies along the Atlantic Coast from Massachusetts to South Carolina. Some Acadians hid from the British in the woods, then made their way to areas still under French control in the region or to Quebec, the Ohio Valley or Louisiana. Others were still hiding in the forest near their native settlements when England claimed ultimate

victory over the eastern part of the continent in 1763. Small groups of exiles made their way back to the region.

Although the Acadians were once again allowed to own land, they could not go back to their home communities except as dykebuilders for the settlers who had replaced them. Between their takeover of the south side of the Bay of Fundy in 1710 and the beginning of the Expulsion in 1755, the British governed their territory at first through appointed Acadian deputies and later (1732) through elected Acadian representatives, also called deputies. As the following proclamation shows, the British certainly appreciated the function and importance of the dykes:

Order for Repairing Dykes of Plsiquid

Preamble refers to people so indolent as to neglect barriers and fences, by which the fruits of the earth are destroyed, to the detriment of their neighbours and the public weal. All ordered expressly to keep their dykes, barriers and fences in repair. A fine of fifty livres imposed: and the negligent person required to pay "double the charges of all Damage & Expense" that the injured person thereby sustain. As a preventive measure three of the Deputies and two of the "Ancient" inhabitants (Acadians) are to inspect the dykes every spring and fall and direct repairs. The owners of such unruly cattle as break through or jump over fences declared good by the Commission must dispose of them, or be under the same penalties as those who do not keep their dykes in repair.

— Annapolis, April 17, 1735
L. Armstrong
(*From the Commission Book,
Nova Scotia Archives*)

Chapter V

Acadian Dyke Building



In attempting to keep the saltwater off the marshland they wanted to develop, the Acadians had two problems to solve. First, to build the dykes high enough and strong enough to hold back the sea, and second, to find a way to discharge into the sea the fresh water that accumulated from various sources behind the dykes.

The settlers solved at least one of their problems by inventing what they came to call an *aboiteau*. Basically, this was a small wooden tunnel with a hinged door inside. The door would swing open to let the fresh water drain out but close to keep out the tide. This tunnel or sluice was placed in the channel of a creek bed and covered with layers of spruce brush and tramped-down marsh mud until the channel was blocked to the same level as the top of the dyke. Aboiteaux became so central to dyking that the colonists came to call their entire system of reclamation Les Aboiteaux. Throughout the last part of the seventeenth century the Acadians continued to build dykes in the traditional way (hollowed logs). However, with the appearance of sawmills and the need for larger sluices, squared timbers could now be used.

To keep labour and materials to a minimum, the Acadians made their dykes as short and narrow as the highest tides would allow. Built of marsh mud and faced with sods, the tallest dykes might be two meters high with a five-meter base and a level top 60 cm across. The smallest would be about 60 cm tall. All their dykes had steep slopes in a ratio of 1:1 (one unit of vertical climb for every unit of horizontal distance. A slope of 1:1 is at a 45° angle to the ground).

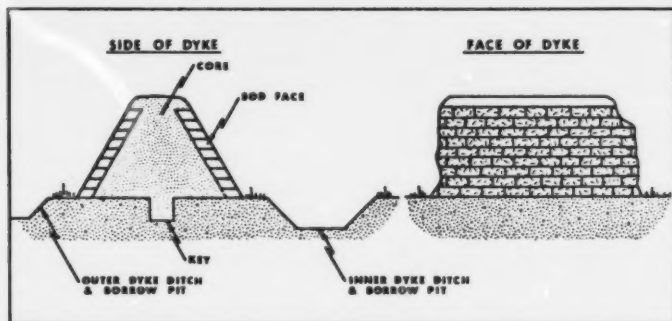


Figure 8 This drawing shows a typical hand-built dyke as used by the Acadians. The top width would be from 30-60 cm wide with 1:1 side slopes. The sods or permangues were cut from saltmarsh sods using the very sharp dyking spade.



Figure 9 A hand-built dyke holding back the tide on the Aulac Marsh. Note the narrow top, steep sides and the borrow-pit at the top of the dyke. In the background are bay storage barns.

A crew of eight dykebuilders would find a suitable site of firm marsh near a good source of sods. George Frail, an engineer who grew up on the Canard dykelands, remembers looking for patches of 'black grass' for sods because its wiry roots bonded so well with marsh mud.

During a period of neap tides, construction began by cutting a shallow, narrow trench down the middle of the proposed path of the future dyke. This 'key' locked the dyke into the marsh mud and prevented it from sliding. Without the key, salt water could seep in between the new mud of the dyke and the old mud of the saltmarsh surface and separate the two altogether. A strong tide could then push the dyke — or part of it — several decimeters inland, causing a break.

For digging the compact, wet marsh mud the Acadians used a dyking spade. Long, narrow and light, it was designed to handle the heavy soil in workable amounts. Because marsh mud holds its shape so well, the straight, flat end of the spade allowed dykebuilders to cut ditches and sods with flat sides.

The second step was to cut the grass sods for the steep face of the dyke. The Acadians created the smooth sides of their dykes by digging the sods in 'bricks' (*permangues*) 10 cm wide, with the grass side at a 30° angle.

To form these identical building blocks, the builders strung a line between two stakes along an area of good sod material near the dyke site. The sod cutter, cutting at right angles to the line, dug out a triangular divot. The first cut was straight down; the second at 30° to the surface. Then the sod cutter made another 30° cut about a spade-width down the line, producing a sod with a grass face of 30°.

As the sod cutter continued digging *permangues*, the second man lifted the loosened sods out of the trench with a pitchfork, loading them onto a drag pulled by an ox. A third man led the animal to the nearby building site, where a fourth man arranged the bottom row of sods for each side of the dyke. Once these *permangues* were in place, two other men started digging marsh mud along the other side of the dyke and throwing it in between the rows of *permangues*, filling the dyke 'key' trench in the process. The ditch formed outside the dyke by this operation was called the *borrow pit*.

After the fill went in, the marsh mud was packed down tightly by foot, perhaps by the man who arranged the sods or by another two men. Once tramped-down fill reached the top of the first row of sods, the next layer of sods went on and the process continued until the dyke reached the planned height.

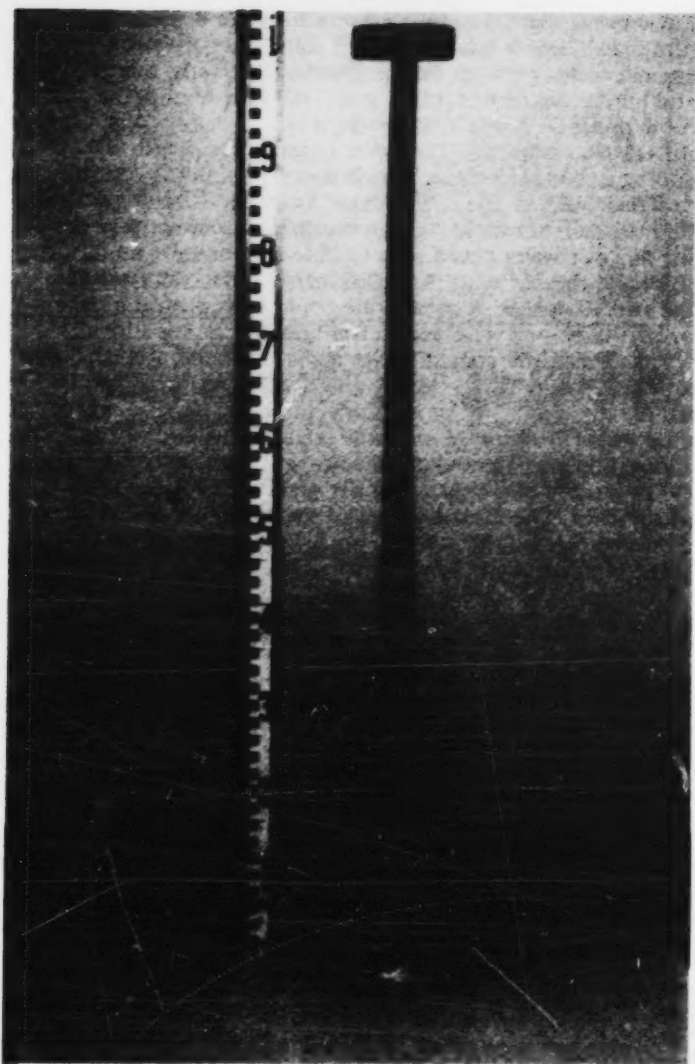


Figure 10 A dyking spade typical of those used by the Acadians to cut sods for dyke facing.

Other variations in technique might include piling up all the earth fill before covering it with permangues. In any case the result was a smooth, well-grassed surface. The roots would reach into the fill and hold the dyke against erosion by the tides.

Only a well-made dyke could stand up to the battering action of the saltwater. The permangues had to be cut a uniform shape so they would fit snugly together. Otherwise water would soon rush into any spaces between the sods and start washing out the fill. In time the tide would cut a channel through the dyke.

Dykes could also fail if the builders neglected to dig a key, failed to do a good job of tramping down the fill, or used sods with poor root systems.

Sometimes the Acadians found that sods were not enough to protect dykewalls from erosion, especially in locations exposed to the full force of the tide. So they faced some dyke walls with brush held in place by stakes and faced others with planks. In the plank-facing method, the planks would be held in place by cross-planks anchored to a log inside the dyke fill.

Even more difficult to build were the aboiteaux. Once the Acadians had put up dykes along both banks of a tidal creek, smaller volumes of water would be confined to a narrow channel. However, to shut off even this flow, the work had to be done quickly, between tides. Unless the channels were completely closed, an incoming tide could wash away most of the work already done.

The Acadians managed this problem by breaking the job down into several steps. They would build a first aboiteau well upstream where the creek was fairly narrow. The small structure required at such a site could be built quickly between tides. As a result, the amount of saltwater entering and leaving the tidal creek would be greatly reduced, and a second aboiteau farther down the channel could be all the more easily built. Eventually they would tackle the large aboiteau necessary to close off the tidal creek at its mouth.

The first step in aboiteau construction was finding a firm clay foundation in the creek bed. For the sluice, a large log was cut to the proper length, then shaped into a trough. Axe and adze made the rough cut, then hammer and chisel smoothed out the hollow. The trough was cut a bit deeper near the large end of the log to allow for the swinging gate. The sluice door was made of hardwood plank cut so it had two 'horns' at the top to act as hinges. The horns were rounded off and rested in grooves cut in the top of the

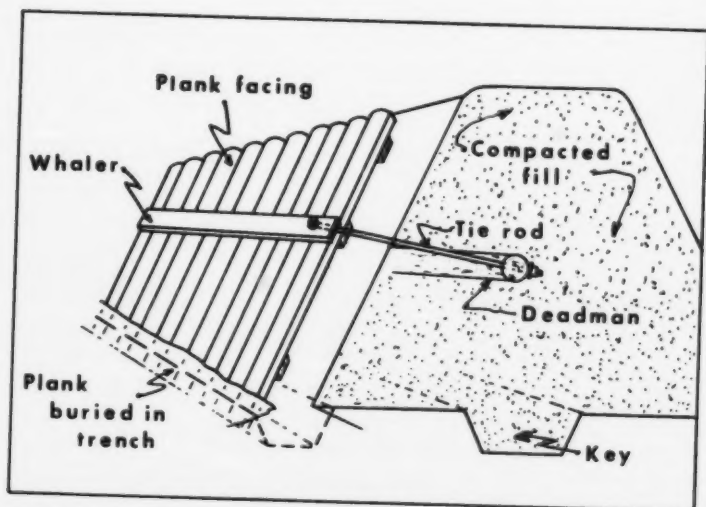


Figure 11 A typical method of installing plank facing to dykes to protect them from erosion due to wave and tidal current action. (Drawn by MRMS)

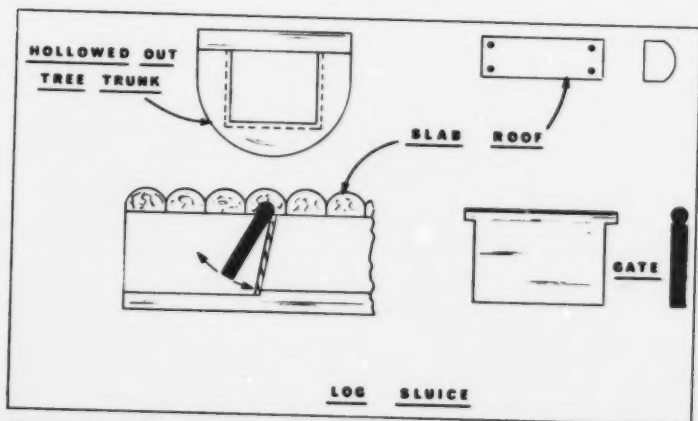


Figure 12 Sketches showing a method to build an early Acadian aboiteau from a hollowed log.

trough. When shut, the gate closed against the ridge made by the more shallow cut in the rest of the log.

A series of short slabs of wood across the top of the trough formed the sluice roof. These were fastened by wooden pegs to the sluice. As the tide went out during a period of neap tides, the creek bed would be levelled, if necessary, and the sluice set in place. Marsh clay was placed around the sluice and firmly tramped into place. Then alternate layers of fine brush and mud fill were added on either side. For the brush they used spruce or fir trees about as long as two-thirds the width of the aboiteau. (A tree laid across the entire back-to-front width would create a small channel in the structure which the tides could penetrate and widen.) The first layer of brush would extend trunks-first from one side. Then, after a layer of fill, the next layer of brush would extend across from the other side.

Although timber sluices would replace logs, among other changes, the basic method of dykebuilding remained basically the same for about three hundred years, ending only when modern machinery appeared on the dykelands in the 1940s and 50s.

Drainage was a constant problem for the Acadians. Water did not pass through the impervious dykeland soil easily. The annual rainfall was high; there was no drainage in the winter; and the soil was heavy with water in early spring.

On large flat areas, the Acadians created strips of land later called *dales* by digging parallel ditches one chain (66 ft., 20 meters) apart. The dales themselves could be as long as several hundred meters, depending on the lay of the land. Sometimes a series of smaller ditches (laterals) were dug across the dales at right angles to drain into the dale ditches. Where the land surface was uneven, the low spots were drained by digging ditches along the path of least resistance to the nearest dale ditch, lateral, or tidal creek. In all cases, the water eventually drained out through an aboiteau.

The traditional drainage system was often a hodge-podge of irregular ditches, small flats and uneven surfaces — an arrangement that caused no problems when agriculture was based on hand work and animal-drawn equipment.



Figure 13 A hollowed-log aboiteau sluice removed from a dyke at Belleisle, Annapolis County, in 1981. The near end shows a shoulder that the wooden gate came against when it closed with the incoming tide. The top of the sluice was covered with wooden slabs attached to the log with wooden pegs.

Eye-witness Accounts of Acadian Dykeland Agriculture

The settlers join together to dyke several large pieces of land. At first, they farm these together. Later, they are divided into a number of smaller fields. Their dykes are made of large sods of marsh. These are cut into square pieces. They pile these up about five feet higher than the surrounding marsh. They make them thick enough to keep out the strongest tides. Soon, the sods grow very firm and long lasting. They become grown over with grass and often have footpaths along their tops. These paths are both useful and very pleasant.

— Otis Little

To grow Wheat, the Marshes which are inundated by the Sea at high Tide, must be drained; these are called Lowlands, & they are quite good, but what labour is needed to make them fit for cultivation! The ebb & flow of the Sea cannot be easily stopped, but the Acadians succeed in doing so by means of great Dykes, called Aboiteaux & it is done in this way: five or six rows of large logs are driven whole into the ground at the points where the tide enters the Marsh, & between each row, other logs are laid, one on top of the other, & all the spaces between them are so carefully filled with well-pounded clay, that the water can no longer get through. In the centre of this construction, a Sluice is contrived in such a manner that the water on the Marshes flows out of its own accord, while that of the Sea is prevented from coming in. An undertaking of this nature, which can only be carried on at certain Seasons when the Tides do not rise so high, costs a great deal, & takes many days, but the abundant crop that is harvested in the second year, after the soil has been washed by Rainwater, compensates for all the expense. As these Lands are owned by several Men, the work upon them is done in common; if they belonged to an Individual, he would have to pay the others, or give to the Men who had worked for him an equal number of days devoted to some other employment; that is the manner in which it is customary for them to adjust such matters among themselves.

— Diéreville, 1699

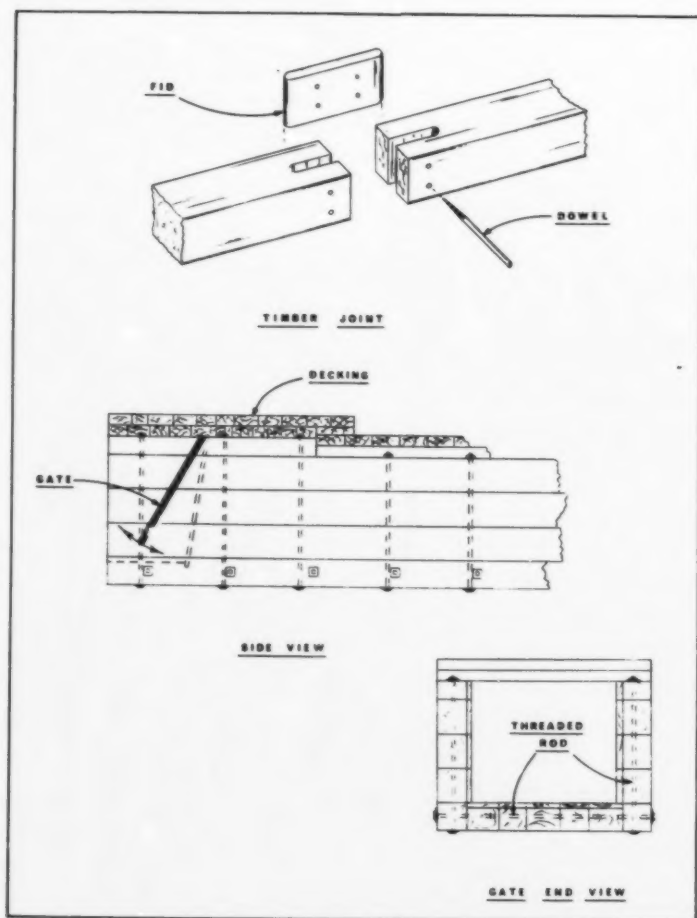


Figure 14 Sketches showing the methods of constructing an aboiteau using sawn timber. This type of aboiteau followed the hollowed-log type.

Chapter VI

The First Major Reconstruction of Dykes

There is no employment of capital which would yield so great a return to the public and to individuals as the dyking of these marshes.

— Letters of Agricola (John Young), #14, Oct. 21, 1818.



In the last half of the eighteenth century, New Englanders, Englishmen, Irishmen and Germans settled on the vacant Acadian dykelands. They not only began clearing upland that had been ignored by the Acadians but, after a rough start, continued the process of dyking saltmarsh. Unlike the Acadians, however, the new settlers did not use the tidal soil for a wide variety of crops, but primarily for hay and pasture.

The first wave of immigration onto the dykelands consisted of New Englanders, invited to the colony through an advertisement in the *Boston Gazette* in October, 1758. Agents sent by groups of prospective settlers liked what they saw and as a result 7,000 New Englanders came to Nova Scotia during the early 1760s.

By 1764 new townships had been created out of the old Acadian communities. The dykelands of old Port Royal became part of Granville Township north of the Annapolis River and Basin, and part of Annapolis Township on the south side. Two townships separated by the Cornwallis River — Horton on the south and Cornwallis on the north — were established to include the Minas dykelands. The Pisiquid area was reorganized into Windsor Township on the east side of the Avon River, and Falmouth Township on the west side.

Cobequid dykelands became part of the Londonderry and Onslow Townships on the north side of the Salmon River, and Truro and Douglas Townships on the south side.

At the head of the Bay, Fort Cumberland came to include old Beaubassin. Three townships took in all the old

dykelands: Cumberland, between the Aulac River on the west and the Le Planche; and Sackville, to the west of the Aulac.

In 1756 three townships were created in what was to become New Brunswick: Hopewell, centred on the Shepody River; Hillsborough, south and west of the bend (the site of present-day Moncton) on the Petitcodiac River; and Moncton, on the north side of the Petitcodiac from the bend to the head of tide. Hillsborough was granted largely to members of the Nova Scotia government while Hopewell and Moncton were settled by German, Welsh and Irish from Pennsylvania.

The population of all of Nova Scotia (the present-day Maritimes) had been estimated in 1764 at 13,000, including 2,600 Acadians.

When the New Englanders began arriving in the early 1760s they found only some of the dykes in good repair. The rest had either been destroyed during the deportation, had fallen apart through lack of attention, or been badly battered by a great storm in November, 1759. Even so, rehabilitating the dykelands was a more direct route to the new settlers' survival than their own traditional practice of clearing the upland.

In 1760, the Nova Scotia government recognized the importance of maintaining dykeland in the preamble of 'An Act for Appointing Commissioners of Sewers,' the first 'marsh act' for the Maritimes:

Whereas great quantities of marsh, meadows, and low ground in this province, and particularly in the Bay of Fundy, and rivers, bays, and creeks, branching therefrom, are spoiled by overflowing of the sea, and other waters which by industry may be greatly improved, as well for the general good, as for the benefit and profit of the owners; and also much meadow and pasture land might be gained out of swamps, and other rough and unprofitable grounds by dyking and draining the same; to the intent therefore, that the new settlers and other proprietors of said marshes, meadows and low grounds, may be encouraged and enabled to raise dykes, and remove such obstructions as prevent these lands from being immediately useful; Be it enacted . . .

The Act went on to state that any group of proprietors could choose an appropriate number from their ranks to serve as commissioners of sewers. Three officials would be responsible for deciding what work should be done to protect dykeland or reclaim marsh, for arranging labour and materials, and for raising all costs from an assessment on the owners' tidal lands.

Although commissions may have been established right away, maintenance, much less construction of protective works, was outside the experience of the new settlers. Fortunately, they were able to hire Acadians who had been detained at British forts to 'assist and instruct' in the work.¹ Around the Minas Basin, at least, Acadians handled dyking chores for the new settlers for several years.²

Two groups that had less trouble adjusting to dykeland agriculture were established at the head of the Bay by former Nova Scotia Lieutenant Governor Michael Franklin in the 1770s. He invited several families who had escaped deportation from Minas in 1755 to become tenant farmers at Minudie, and recruited settlers for Sackville and Cumberland townships from Yorkshire. The Yorkshiremen were experienced farmers with capital and determination. Some of them came from the Vales of York and Pickering where damp, often water-logged carr or fenland was made productive by ditching, draining and the construction of floodgates.³

When the American Revolution ended, more than 20,000 United Empire Loyalists flooded into the Maritimes from the fledgling United States, creating new settlements along the Atlantic coast and up the river valleys of present-day New Brunswick, as well as on dykeable marsh on the Bay of Fundy. Many of these new settlers hoped to establish British-style country manors, based on agriculture.

The arrival of the Loyalists created local markets for the lumber, crops, cleared land, and house room, and the skills of the earlier settlers, many of whom had evaded the expulsion of the Acadians. However, there were some land-claim disputes between the two groups, especially north of the Bay of Fundy. As a result, New Brunswick was created a separate province in 1784 with the Missaguash River serving as the border with Nova Scotia. The portion of Cumberland Township not in Nova Scotia plus Sackville Township and the settlements along the Petitcodiac and Memramcook rivers became part of Westmoreland County, New Brunswick. Cape Breton was also made a separate province in 1784.

The population of Nova Scotia alone reached an estimated 30,000 by 1790.⁴

In 1817 the majority of Nova Scotians did not live near tidal lands. The census for that year showed less than 40% of the population of 82,053 in counties with dykeland.

By the time T.C. Haliburton wrote his *History of Nova Scotia* in 1832 most Fundy dykelands were used for hay and pasture and, occasionally, grain. For most of their grains,

vegetables and root crops, Maritime farmers cleared nearby upland and interval (valley) land. A typical farm unit on the Bay would include both dykeland and upland, even if the dykeland holding were only an acre or so used exclusively as a source of fertilizer for the upland. Haliburton mentions that in Hants County and at other locations around the Minas Basin, neighbours would sometimes gather for a 'mud fling' to cart and spread the tidal soil in much the same way as they might get together for a barn raising, or a quilting bee — or to build an aboiteau.⁵

In his history, Haliburton included observations on every part of Nova Scotia, backed up by a detailed 1827 census that showed another large jump in population to nearly 125,000. In his account, the dykelands played a prominent role in the region's agriculture.

From the bastion of Fort Cumberland (formerly Beauséjour) on the Missaguash River, Haliburton could take in

a splendid view embracing the great Tanteimarr and Missaguash meados, Barronsfield, Westmoreland and the country at the foot of the Shepody Mountains. Vast stacks of hay cover the alluvial lands as far as the eye can reach and the substantial farmhouses and numerous herds bespeak the wealth and independence of the Yomanry. . .⁶

Dykeland made up, on average, about 40% of the cultivated land around the Bay,⁷ though the percentage was near 60 in Cumberland County as a whole and well over 90 at Minudie in particular.

Haliburton was impressed by the fertility of dykeland soil, reporting for instance that the 200 settlers of Fort Lawrence Settlement, which lay in a ribbon between the La Planche River and the New Brunswick border, had produced more than 3,000 bushels of grain in 1837. Nearly all the settlement's farmland was dykeland.

However, the future judge was quite upset that grazing had become "the predominant and favourite system of farming" in Nova Scotia.⁸ In describing Amherst Township, for instance, he complained that its dykelands, "though susceptible of the highest improvement, are never disturbed by the plough. These extensive meadows are devoted to English hay and the depasturage of cattle."⁹ (English hay comes from the so-called English grasses: white clover, red clover, timothy, red top and couch grass. These grasses, which replace marsh vegetation as dyked land lose its salt, may have been introduced by settlers who arrived after the Expulsion.)¹⁰

Haliburton blamed the trend to grazing on the "little interest in tillage," the high cost of labour, the low cost of American flour, and the great demand of the British armed forces for beef and pork during the War of 1812. Labour was expensive because so much good, cheap land was available. Each new settler could buy and work his own land rather than work for someone else. Also, since the farmers owned more land than they could cultivate, they were not, according to Haliburton, "at pains of discovering how they can raise their crops within the smallest possible space."¹¹ Even attempts by Lord Dalhousie, he reported, to encourage up-to-date methods of cultivation through agricultural societies, plowing matches and other exhibitions, did not have the desired effect. Haliburton decided that only an increased population would both "reduce the price of labour and increase the necessity of exertion."¹²

Meanwhile, Maritime farmers extended the dykelands well beyond the old Acadian limits. Not content to take in a few hectares at a time, the Maritimes preferred to reclaim large tracts of marsh in a single large-scale operation. The most ambitious such project was construction of the mile-long (1.6-kilometer) dyke built to enclose and drain 214 hectares (528 acres) of saltmarsh on the Canard River in Kings County, Nova Scotia. The work, which took eight years to complete, created a dykeland unit (or *marsh body*) known as the Wellington Dyke.

Meanwhile, on the New Brunswick side of the border, the second and third generations of the English-speaking settlers had been busy turning untouched areas of saltmarsh — and even swamp — into dykeland.

In extending the dykeland, the English-speaking settlers at the head of the Bay added a new technique of their own. In 1815 one Tolar Thompson of Upper Sackville decided he could create some good soil on the boggy back reaches of the Tantramar marshes by digging a channel to them from the Tantramar River. Because the marsh is higher near the river banks than farther inland, silt rarely made its way the two or three miles from the river to Rush Lake. Meanwhile, of course, fresh water could not drain through the compact marsh soil.

The 'Tolar Canal' cut through the higher land to the river. Using an aboiteau at the mouth of the canal, he drained the bogs of freshwater. Then after removing the aboiteau he allowed the tides to run up the man-made channel and silt the Lake area for the next 15 years. A grid of smaller channels branched out from the main one, carrying the silt to desired

sites. After the land had been covered with several centimeters of marsh mud, the process of tiding was completed and Thompson shut out the tide with dykes around the newly silted land. As a result, 365 hectares of former swamp produced good crops for several years.

However, as the organic layer decayed and settled, silt accumulated, as it always does, in the channel outside the dykes, interfering with drainage. The quality of crops deteriorated and eventually much of the land was abandoned.¹³

Other nineteenth century tiding experiments were the Page Canal on the Amherst Marsh from the La Planche River to an area near Amherst; the McCully Canal from the Nappan River in the general direction of Blair Lake; and a large canal excavated from a bed in the Missaguash River in an attempt to tide the lakes and swamps at the head of the same river.¹⁴ All these projects ran into problems when the canals silted up and blocked drainage.

In a manner much like Haliburton's in his earlier history of Nova Scotia, Alexander Monro wrote *History of New Brunswick*, in 1855 which surveyed the province by the area, county and towns. Like Haliburton, he reported the important role of tidal agriculture.

Including the Nova Scotia side of the Cumberland Basin but not the lands along the Petitcodiac or Memramcook rivers, Monro estimated that there were 26,000 acres (10 500 hectares) of dykeland producing hay at the rate of one and a half to two tons an acre (3-4 tons/hectare), some fields yielding hay for upwards of 60 years without manure or any other fertilizer. Another 24,000 acres (9 700 hectares) he deemed "partially productive."¹⁵

Monro went on to observe that since the dykeland is so close to the settlements, farmers have "until very recently" depended on them

for the principal part of their supply of hay instead of raising it from the upland alluvial with which almost every farm abounds. This has tended to render the raising of stock in the more remote settlements less remunerative than it otherwise would have been; and thus it has happened that almost all the hay produced in the county (Westmorland), in 1851, nearly 34,000 tons, was raised on the (dyked) marshlands.¹⁶

During the 1800s, the dykelands were maintained much like a municipal unit. The owners of a marsh body might elect three commissioners from among themselves to manage dykeland affairs. The commissioners, whose busiest times were spring and fall, would decide what construction or repair work was necessary. One of them would patrol the dykes, hire work crews and horse teams, supervise repairs and construction, and act as time-keeper. By the end of the 1800s this commissioner was often called *the* Commissioner.

A second commissioner (or dyke committee member), acting as secretary, would keep minutes of meetings and other records and handle correspondence. A third member would contribute to all decisions and allowed a tie-breaking vote on any split decision. Each commissioner continued to work his own dykeland and upland in addition to his duties.

The commissioners also regularly set an assessment against the dykeland owners for cost of construction and repairs for the previous year. On most marsh bodies there would be a per acre rate so that a family which owned 10% of the dykeland, for instance, would pay 10% of its upkeep. For small projects affecting only a few properties, the owners involved might be asked to bear the whole cost.

One exception to per acre assessment was the 'rating' method used on the Wellington Dyke. Dykeland owners from a neighbouring marsh body gave a value of 100% to the best lot (the property with the best natural drainage) and rated the other lots accordingly. An owner of 10 acres rated 50% would pay only half as much tax as an owner of 10 acres of the highest-ranked land.

Each owner could pay off his share in labour, money, materials or all three. If an owner failed to pay his share, the commissioners could auction off his dykeland.

Marsh bodies around the Bay continued to handle their own maintenance and construction until the federal and provincial governments took over most of that responsibility in the 1940s.

One tradition that has remained little changed to the present day on some marsh bodies is the community pasture. After hay — and in some places grain as well — had been harvested off the dykeland, all cattle and horses were turned out on the 'common fields' on the aftergrowth. The commissioners would measure the amount of feed on an owner's property against the number, type and size of the animals the same owner wanted to pasture on the common fields. A standard unit of consumption was the three acres of

feed necessary to feed a cow during September and October. A three-year-old horse might be counted as 'a cow-and-a-half' while a colt or calf would only be valued as a quarter of a cow.

Dominated by lumbering, ship-building and mining, the middle 1800s were boom years for the Maritimes and farmers around the Bay of Fundy doubtless shared in the general prosperity. However, the period also brought the 'Saxby Gal' of 1869, a violent storm that flooded Fundy dykelands, caused extensive damage to dykes and *aboiteaux*, and drowned at least two people and many animals.

The late 1800s brought a general economic slowdown to the Maritimes. However, a huge demand for exported hay would spell prosperity for many dykeland farmers by the turn of the century. In an age when horses provided the power for lumber camps, mines and urban transportation, the market for Fundy hay extended as far as Boston. Dykeland which could produce two tons an acre climbed to a sale value of \$100.00 an acre and eventually set record prices at \$200.00. New hay barns sprang up across the Tantramar marshes and there was increased pressure to reclaim new dykeland. One response to this booming market was an 1894 attempt at 'tiding' by a 'Missaguash Marsh Co.' This business

was formed to drain the head of the Missaguash River and bring the upper reaches into hay production. . . It worked but only partly and for the wrong reason. After digging the canal 36 ft. wide., 15 ft. deep and five miles long, the farmers discovered the tide wasn't strong enough to carry the silt that far. The original goal of filling the bog was not attained but the canal did offer excellent drainage along the way. Rather than increasing the amount of hay acreage. . . the farmers improved already productive fields.¹⁷

The price of hay sky-rocketed to a peak of \$28.00 a ton in 1920.¹⁸ Around the Cumberland Basin hayfields became a sign of wealth and when a young man started to pay attention to a young woman, her mother might ask "How much (dyked) marsh has he got?" In Amherst the elite social organization was the Marshland Club.

The bubble burst in the 1920s as oil replaced hay as North America's fuel.¹⁹

In 1938 the price of hay fell to \$6.00 to \$7.00 a ton on delivery. After deducting \$2.50 per ton for cutting, \$2.50 per ton for placing in barn, \$1.50 per ton for pressing and 50¢ per

ton for transportation, nothing was left for interest or maintenance charges.²⁰

Throughout the 1930s Fundy dykelands faced a growing crisis. Even farmers in areas that had not been involved in hay exports (but had used dykeland mainly for cattle fodder) were feeling the effects of the world-wide depression. Money for labour and repairs was scarce.

As the thirties came to a close, traditional manual labour for rebuilding and maintaining dykes and drains was being directed into the non-agricultural activities of war-time Canada.²¹ Modern machinery, with its great potential for labour-saving efficiency, was still considered too risky to use on slippery marsh mud. Hundreds of hectares of dykeland were slowly abandoned to the sea. As the 18-year cycle of high tides approached, it appeared that the region would lose tens of thousands of hectares of prime farmland that had taken three centuries to create.



Figure 15 Tantramar Marshes in New Brunswick in 1948. The buildings shown are bay storage barns.



Figure 16 This picture illustrates the destruction to the dykelands that resulted from failure of dykes and aboiteaux that took place in the late 1930s. (MMRA Photo)



Figure 17 A large tract of dykeland that was destroyed by the failure of the dykes in the early 1940s. This photo shows the area at high tide. (MMRA Photo)

Chapter VII

The First Large Structures



Early in the nineteenth century farmers in two regions embarked on the difficult and costly construction of two huge dykes. Through perseverance and hard work these eventually yielded profitable results.

† The Wellington Dyke

In 1816 farmers on the lower Canard River in Kings County, Nova Scotia, decided to save time and eliminate many smaller operations by reclaiming a large area of marsh at once rather than by the Acadian practice of closing off a few acres at a time. That year they began building the required mile-long 'running dyke', with plans for one large and two small aboiteaux. The mammoth project took seven years to complete and required huge amounts of labour and materials.

A journalist reporting the construction in the *Nova Scotian* in 1825, said he

saw the force usually employed — about 100 teams (500 working cattle) and 300 men. There have been used in said dyke 9,778 logs of birch; 18,036 loads of poles 12 ft. long; 71,756 pickets from 8 to 16 feet long; 15,141 loads of stone. . . contracted for, besides thousands which it may justly be said were brought on in the day's work.¹

In describing the aboiteau, he wrote

Imagine a vast pile measuring 50 ft. in perpendicular height — 120 ft. at the base, gradually narrowing at an angle of about 10° till it reaches the top and extending across the whole bed of the river about 300 ft. wide. . . The materials

with which it had been erected are brush, stone, timber, marsh sods, and these fastened together with pickets. . . .
 . . . sluice 100 ft. long, 14 ft. wide, and 4 ft. high with two divisions made of solid timber, twelve inches thick covered first with 2-inch plank then with timber six inches thick.

The difficulties of working on marsh mud were magnified by the size of the project. According to local tradition nine out of every 10 loads of material were washed out. A heart-breaking event in 1822 destroyed much of five years' work:

The Abbateau was raised to a level with the tide and so nearly completed that with but a few days' labour it was expected to shut it out entirely. At this very moment, however, when the point was so nearly gained, an accident occurred, which frustrated all their hopes. One day when the tide was out it was observed that upon the south side of the abbateau, and close to the bank of the river, the water above had forced a leak through the main body of the work; anxiety now filled everyone — no effort could save it — and before half an hour the violence of the water washed away with fearful rapidity the complete side of the abbateau and left the other a shattered and disfigured monument of their enterprise. . . .

Although many proprietors lost heart at this inauspicious event and would have relinquished the scheme as utterly hopeless, some of the leading men of the County stepped forward and recommended a renewal of efforts — hope was again awakened and accordingly in the same summer work was recommenced — continued during the course of this and towards the end of last September (1824), with incredible labour, an abbateau was complete which has since stood and bids fair to satisfy every hope of its stability.

The provincial government provided some of the money necessary for this final closing of the gap. The marsh owners might not have been able to complete the work without such help since several proprietors had mortgaged their properties for generations to pay for work already done and might have been stretched to the limit financially. E.L. Eaton, Kings County historian and Clerk of the Wellington Dyke Marsh from the 1940s through the 1970s, has written that when it came time to repay borrowed money most of the farmers saw their farms sold by the sheriff.²

The new dykeland plus all land previously dyked on the Canard River came to be known as the Wellington Dyke. Not

only did the new dyke allow a new road connection with communities on the north side of the river, but the maintenance costs per acre on the new marsh body became the lowest of any dyked marsh in the region.³

† The Aulac River Aboiteau

In 1804 the owners of saltmarsh near the mouth of the Aulac River decided to dam the river with an aboiteau just upstream from the Basin.

The work went on for more than four years, but the site's quicksand bottom made it almost impossible to build a firm foundation. Though the channel seemed nearly finished in December, 1808, the project ran into more difficulties and was abandoned the following March.

An adventure during the attempt in 1804 to aboiteau the Aulac River demonstrates the dangerous side of traditional construction. The sluice, which would have been about 16 m long, 5 m wide and 2 m deep, had been placed in position in the river bed at low tide.

The men were . . . trying to make it secure with the weight of mud, but the tide coming too quick for them lifted it out of its bed. Four of the Trueman boys sprang on the sluice as it floated down the river in the hope of saving it in some way. It proved however, to be a most unmanageable craft and they could do little to stay their course down the river, and in spite of every effort were carried out into the Basin. Night came on and their only chance of safety was, if possible, to stick to the plank box in the hope, that the currents might carry them to some point where they could get safely to shore. Next day their unwieldy craft grounded near Nappan, and they at once landed and were hospitably entertained at a farm house nearby. After getting supplies and sending word to Prospect (The Trueman farm) of their safety, they again boarded their strange vessel and succeeded that day in getting back to the mouth of the river and finally back to their starting point.³

Another attempt was made to aboiteau the Aulac in 1829. This time a good foundation was found less than a kilometer down the river from the earlier site. However, this structure was in turn

superseded in 1840 by the Etter aboideau, which was thrown across the Aulac about two miles nearer the mouth of the river. This latter work was very expensive to maintain. The foundation in one place

seemed to be resting on quicksand and was constantly settling. In 1860 it was decided to abandon the structure and build a new one about two hundred yards up the river. Two years were taken to finish the new work, and in the meantime the old aboideau was kept in repair, which gave much better facilities for working at the new one. When the Eastern Extension Railroad was constructed, (1872), a right-of-way was secured by the company over the new aboideau, and later when the road came into the hands of the Dominion Government, an arrangement was made with the commissioners of the aboideau for maintaining the work...⁴

The arrangement with the railroad has continued into the 1980s. The tracks run along the top of the dyke, which protects 820 hectares of farmland as well as a stretch of the Trans-Canada Highway just inside it, between Amherst, Nova Scotia and Sackville, New Brunswick.

Chapter VIII

The Saxby Storm



n 1868, S.M. Saxby of the British Navy predicted an exceptionally high tide for 7 a.m., October 5th, 1869 that would cause "marked atmospheric disturbance" around the world. The prediction was printed in the *London Standard* and widely circulated.

The appointed day saw little damage along Nova Scotia's Atlantic Coast, but contemporary press reports show Saxby's prophesy sadly accurate for the Bay of Fundy:

From Windsor: About 11 o'clock Monday night four dykes at Poverty Point, near Smith Island, gave way, and ten minutes afterwards the lowlands for miles around were flooded, and their contents much damaged. The inmates were compelled to take refuge in the upper stories. Many cattle and sheep were drowned. Mr. P. Miles lost 34 sheep. The tide rose four feet higher than it was ever known before. . . . At Falmouth and Newport the dykes were carried away, and the land flooded. At Horton, and upon the Grand Pré dykes, a quantity of hay was destroyed and numbers of cattle drowned, some of which drifted out to sea. Bridges were carried away or destroyed. . . .

— *Halifax Chronicle*, Oct. 8 (1869)

From Cumberland: The tremendous tide . . . swept over the whole of the marshes of Cumberland and Westmorland. . . . When it was considered that almost every farmer adjacent to a tract of (dyked) marsh depends upon it for the principal part of his hay, and that this, after being cut, remains for the most part, on the ground in

stacks, or in exceptional cases in barns, to be hauled in the winter, the great extent of the losses may be more nearly approximated. But the loss of hay now, great as it is, embraces but a small portion of the damages to proprietors of (dyked) marshes. The expense of repairing, and in many cases renewing miles of heavy dykes; and the injurious effects upon future grass crops for years, through the action of the tide, to swell up the account of losses. . . . At half past 10 o'clock on Monday night the dykes overflowed. The water having gradually accumulated on the marshes to the depth of from one to two feet, a wave, similar to the tidal bore, swept up with a rearing noise and great velocity, carrying almost everything before it; stocks of hay, fences, and in many cases, well filled barns succumbing to its power. Four men who went to Fort Lawrence creek to secure a schooner sought shelter from the wind in a barn. The tide rising, they abandoned the barn and took to a fence which extended from it to the upland, and by passing along which they hoped to be safe. The waves swept away the fence. Two of the men managed to reach some poles and save themselves. The others. . . were drowned. An old man named Steward, belonging to Minudie, engaged in cutting grass at Minudie Point, was in the habit of spending his nights in a barn there. On the Terrific night, finding the barn afloat and breaking up, he succeeded in clinging to a passing haystack. After being for some time at the mercy of wind and tide, hope almost failed as he was being fast borne seaward, when his life-buoy grounded on the top of the dyke, seemingly at the very brink of destruction. He was rescued by means of a boat on following day. A horse which was in the barn was drowned.

— *Amberst Gazette*, Oct. 18

From Windsor: Ten days after the Gale: The floods have abated. On Tuesday the last field was left dry, and now nothing but a barren scene meets the eye in every direction. The beautiful green afterfeed of the dykes is turned into a muddy brown marsh, which produces and unhealthily dismal fog and a sickening smell; fences are lying strewn in every direction; hay stacks are racked and ruined, and occasionally the carcass of a dead animal is seen bleaching in the sun. A meeting of dyke holders. . . voted. . . to repair the Tragothic or Big Dyke. . . the Town dyke at Avondale will not be repaired, as the rates are so high that it will not pay them for their trouble. . .

The date of the Saxby Gale may have been related to the relative positions of the earth, sun and moon at the time, which occurs every 18 years, 11 days, and 8 hours. The ancient Chaldeans called this recurring pattern the Saros Cycle. The great storms of 1705, 1759 and the Saxby Gale all happened at the same point in the cycle.

Chapter IX

The Advent of Machines and Government Aid



In September 4, 1944, the tide broke through the aging Habitant Aboiteau in the middle of Canning, Nova Scotia, sweeping away the main highway bridge and flooding hundreds of hectares of dykeland along the Habitant River with saltwater. The village was swamped and the incoming ocean current threatened the trestle of the Dominion Atlantic Railway.

When owners of the neighbouring Wellington Dyke announced that the sluice in their main aboiteau would also soon wear out unless they got government support, the public was ready to listen to their problem with respect.

The Wellington Dyke not only contained more than 1 000 hectares of prime agricultural land (10 times as much dykeland as behind the dykes at Canning), but protected many public utilities as well.

In a letter to the various levels of government requesting help,¹ the 165 owners explained that they made a good living from their dykelands and did not want to lose them. Nor did they want to see most of the area deprived of its cattle feed. The Wellington Dyke produced an average of five tons per hectare of hay or its equivalent in grain, providing fall pasture and winter fodder for 2 000 cattle and horses. Further, owners of the dyke had kept 'running dykes' and aboiteaux in good repair without any public or private support since 1823 despite the fact that the dykes protected two main paved roads, twelve railway bridges, several kilometers of gravel roads, the railroad line to Kingsport as well as telephone and power lines.

However, they said, depressed prices for hay and cattle and

the high cost of labour left them unable to afford all the necessary repairs themselves. They certainly would not be able to afford to reclaim the land should it be lost. And if the dykes failed, the province would be forced to replace roads and other utilities at great expense. Hand in hand with formal requests for government help, the owners mounted a publicity campaign to get the public behind them.

Other dykeland owners throughout the region faced similar threatening situations. The very existence of dykeland in the Maritimes had reached a critical stage.

Fortunately, the ground work for a large-scale rehabilitation of the dykelands had already been laid on several fronts. In 1939, modern machinery was used on a major dyking project for the first time, opening the way for other large projects in a time of labour shortages. A section of the East Dyke at Grand Pré would fail unless 580 meters of new dyke were built inside the existing sea wall. The commissioner for the Grand Pré Marsh, Robert Palmeter, hired a contractor to do the work with a drag-line, despite protests from other proprietors that dykes could only be built by hand or that machine work would cost too much.



Figure 18 One of the first bull-dozers used for building dykes in the Maritimes working on a dyke at the Experimental Farm, Nappan. (Photo from Report on Dykeland Reclamation)

The drag-line travelled around on mats of 15 cm x 15 cm timbers bolted together — unless the ground was extremely dry. When the operator was ready to move forward, his helper would hook a chain from a mat to the drag-line bucket. The operator would swing the mat to a position just ahead of the one on which the machine was resting, then move the machine ahead from one mat to the next. The experiment was successful. In fact the project set a new local record for efficiency (cost per cubic yard of fill placed).

Also in 1939, the Nova Scotia Department of Agriculture carried out a survey of tidal lands in Cumberland County. This 'Nova Scotia Marsh Survey' indicated problems common to Maritime dykelands that year.

The survey covered 5 300 hectares, of which 400 were "waste"; 3 200 were in "broad-leaf" (salt-tolerant vegetation such as cord grass, etc., used as a supplementary fodder), and the remainder in "English" grasses. Among its conclusions:

The marshes in Cumberland have seriously depreciated, the greatest change being in the past 5 or 6 years. . . The chief problem is the lack of drainage and the high cost of diking. . . Some areas are in good condition and the owners need little outside assistance; other areas, now only partially productive could be greatly improved by better drainage which would require some outside assistance; a few areas cannot be made productive without a large-scale project (diking or breakwater or main canal) which is definitely beyond the capacities of the land owners. . . If reclamation is not undertaken soon, large areas will be completely abandoned or future reclamation work will be much more difficult. . . The organization of the (dykes) marshlands has been fairly satisfactory in the past. A special study by an appointed committee would be advantageous. . .

Owners who were able to keep their lands fairly well drained and their dykes in good condition were receiving reasonable return and did not doubt the value of the land, according to the survey. However, owners who were having a hard time maintaining their dykelands — especially proprietors of lands most exposed to the sea — were quite discouraged and were beginning to think of their tidal lands as a 'white elephant.'

Some owners were frustrated by operators of neighbouring lands who either could not, or would not, provide the money necessary to keep aboiteaux and dykes in good repair and main drainage channels open. There were absentee speculators



Figure 19 Drag-lines in the 0.6-0.8 m³ size range working on timber mats, are particularly successful in moving unstable dykeland soil. (MMRA Photo)



Figure 20 The sea side of the Grand Pré Dyke at the 'Great Discharge Aboiteau' in the early 1940s. Note the brush-matting and plank-facing in use at the time. (Photo Nappan Experimental Farm)

who bought acreage during the hay boom but no longer paid attention to their lands. And there were owners badly hit by the Depression who simply did not have money to give.

As always, the health of a marsh body depended on joint maintenance. A farmer who worked hard to dig good drainage ditches on his land, for instance, would find his efforts useless unless he could get enough co-operation from his neighbours to keep the main channel or tidal creek flowing smoothly. If not, his own run-off would be trapped.

† Pressure for Aid Mounts

While World War II continued, pressure mounted for government help. Dykeland owners and other concerned Maritimers pointed to the Prairie Farm Rehabilitation Act, which had been set up by the Federal Government to combat drought conditions in the West. They felt a similar program should be established to prevent flooding on the dykelands in the East.

E.S. Archibald, head of the Central Experimental Farm in Ottawa (who had worked on the dykelands in the Truro area in his youth) took the first formal step to establish such a program. In his estimates for the Experimental Farm portion of the Federal Department of Agriculture budget for 1942, Dr. Archibald outlined a joint federal-provincial committee to study dykeland problems.² At the same time the Nova Scotia and New Brunswick governments agreed to match "dollar for dollar" any federal money directed to dykeland repairs.³

The Federal Minister of Agriculture, Hon. James Gardiner, threw his weight behind government involvement when he stated that the deterioration of the dykelands was "an extraordinary circumstance of war-time emergency" and therefore could not be put off until after the war. If the Maritimes lost such a valuable source of feed for livestock, he argued, meat would have to be brought into the region from the West — at great expense to the war-time economy.⁴

In September, 1943, Dr. Archibald called a meeting of dykeland owners, agricultural officials and engineers, at Amherst, Nova Scotia, to discuss the regional situation. The conference set up the Maritime Dykeland Rehabilitation Committee (MDRC), made up of four representative dykeland owners, four engineers (two each from Nova Scotia and New Brunswick), one soil specialist and a federal government representative. The aims of the new organization would be to

consolidate all present information on each dykeland and where such is not available, to

institute a survey as required; to examine each (marsh) body and report on those worthy of reclamation and to study conditions of dykes, aboiteaux and drains on all bodies, to prepare estimates on required projects; and to recommend a funding arrangement among federal and provincial governments and private owners.⁵

As a basic cause of dykeland problems was the high cost of hand labour, the gathering discussed the methods and machinery for dyke construction and for cleaning drainage ditches and tidal creeks. They decided to "start experimental projects by hiring machines and labour, thereby providing important information on suitable types of machinery to be used."⁶

The conference also decided to treat dykeland and reclamation as a single Maritime project, though each dykeland region would be represented by an advisory committee.

The MDRC held its first formal meeting the following month. The original membership was:

Prof. Angus Banting Engineer	Nova Scotia Agricultural College,
J.E. Belliveau Engineer	Department of Highways, Halifax
Arnold Roberts, Engineer	Department of Agriculture, Fredericton
Donald Oxley Engineer	Department of Highways, Sussex
Charles T. Logan Dykeland Owner	Amherst Point, Nova Scotia
LeBaron Troop Dykeland Owner	Annapolis, Nova Scotia
Ormond Calhoun Dykeland Owner	Albert County, New Brunswick
Donald C. Harper Dykeland Owner	Sackville, New Brunswick
Dr. George Smith Soils Specialist	Nova Scotia Agricultural College, Truro
W.W. Baird Chairman	Superintendent Dominion Experimental Farm Nappan, Nova Scotia

Already, late in September, two preliminary surveys of dykelands around the Cumberland Basin had begun, on both sides of the provincial border, funded by the Experimental Farm. Both parties were made up of 17 or 18 university students under an experienced surveyor.

Although such grand aims had been proclaimed, the first project under the MDRC was a disappointment. Arnold Roberts, who supervised the Sackville-based New Brunswick crew, described the bulk of his time on the project as "spending three-and-a-half hours driving several students at a time to the work site and the same amount of time ferrying them back in the afternoon."⁷ J.W. Byers, chief of the Amherst-based Nova Scotia crew, said, "A couple of the students were interested in the work; the rest just had fun." He recalls the project was "a waste, while dykes broke all around the Bay."⁸

Even so, Nova Scotia, New Brunswick and Ottawa agreed a short time later to divide the cost of repairs evenly between the dykeland owner, his provincial government and Ottawa. In most cases, projects recommended by the MDRC were financed this way so that the administration of the work soon came to be called simply the 'three-way programme.' As everyone involved began to realize the extent of the problem, it was also called the 'Emergency Programme.'

For a marsh body to get help with repairs through the Programme, the commissioner or clerk (secretary) would approach the MDRC with an outline of the work to be done. The field staff examined the project and estimated the cost, then passed on their figures to the MDRC for approval. Wilf Byers had said that early in the Programme "We would walk along the dyke, pacing out the length of weak sections. We might decide for instance that 800 feet of dyke would hold and 200 would go."

When the requests for help came before the MDRC, owners on the regional committee were able to say which areas had good land and available labour. "It was a valuable contribution," according to Byers.

Most repairs were done by the dykeland owners themselves with only occasional checkups by the MDRC. Sometimes the owners were able to find an aboiteau builder who could take care of the job. Large projects, however, were another matter. When a big aboiteau went out at Harvey Bank on the Shepody River, Arnold Roberts supervised the first attempt in New Brunswick by the Emergency Programme to use modern machinery. The experiment did not go smoothly. After spending \$3,000 in 1944 on building a bridge so it could support the heavy construction equipment, the crew had an

extremely difficult time trying to close the channel and finally gave up the project.⁹

In practically all jobs, the finished dyke and aboiteau were carefully measured to determine the volume of fill that had gone into the job. Later, the project would be analyzed on the basis of overall cost per cubic yard of dyke and aboiteau. Eventually, the cost of a proposed job could be estimated by the volume of fill and the size of the sluice.¹⁰

According to Byers, it was sometimes difficult to find good commissioners or experienced dykebuilders. Roberts recalled with a chuckle his trouble on one occasion lining up a labour crew and a horse team for the project. "Half the battle was getting them to show up at the same time!"

The biggest project administered by the Emergency Programme in 1944 was the Habitant Aboiteau at Canning. Several repairs had been made to the dyke by the owners in the fall of 1943, but as the ice made its way out of the aboiteau the following spring, the dividing walls of the three-barrel sluice were broken. The sluice could no longer support the load of the fill on top of it and began to cave in.

Owners of the Habitant Marsh applied to the Emergency Programme for help in rebuilding the sluice, repairing sections of the dyke and erecting a new aboiteau nearby. The new section would bring in another 53 hectares of marsh and eliminate the need for a dyke that was difficult to maintain. The estimate for the work was \$11,000.00.

By July 11th, the aboiteau at the village had settled so badly that the road crossing over it had shrunk to only a meter or less in places and was, of course, impassable. A kilometer of third-class road on the dykeland had been closed.

After the aboiteau washed out so dramatically two months later (as described at the beginning of this chapter), the MDRC forged an agreement with the dykeland owners, the Nova Scotia Department of Highways, and the Dominion Atlantic Railway to finance the construction of new aboiteau at the site proposed several months earlier. The new dam would carry the highway.

Construction of the new Habitant Aboiteau, downstream from the old one, began in October and was completed one year later. It was one of the largest built in the Maritimes up to that time. The sluice was 37 meters long, with three barrels (waterways), each measuring 1 m x 1.5 m inside measurement, and required 50 000 board feet of hardwood timber. The fill amounted to 72 400 cubic meters of rock, earth and brush. The aboiteau at Canning was also the first Emergency

Programme to use *piles* for supporting the sluice. Logs nearly 15 meters long were driven into the marsh mud as far as they could go, then cut off at a uniform height to provide a flat, stable platform.

Building the sluice and getting it in place caused a few problems, but closing the channel was another story. Bulldozers were used to push earth into the gap. But as the channel narrowed the current began washing it away. The solution was to build log and rock cribs across the river below the site. Water flowed freely through the cribs, but the velocity of the current was reduced enough for the work to continue. Finally, fill was placed on the upstream side of the crib to shut off the incoming tide and bring the whole aboiteau up to grade.

The final cost of construction was \$234,631.93 — more than 20 times the estimated cost of the 'preventive' work proposed by the owners two years earlier.

As work on the Canning aboiteau was winding up, dykeland owners on the neighbouring Wellington Dyke won provincial and federal support in rebuilding *their* failing aboiteau. Ottawa would pay half the cost of the work above \$60,000.00 (to a maximum of \$30,000.00), while Nova Scotia agreed to share the remaining cost equally with the dyke owners.

The builders had seen the problems faced by the Canning project in closing the channel, so they decided to build the Wellington Aboiteau *in the dry* — behind the dyke just south of the old aboiteau, out of the path of the existing channel. The construction crew, of course, did not have to contend with water at all. They built the 37-meter sluice on brush mats of wire birch laid across 12" x 12" wood sills (no piles) and covered the sluice with fill up to the level of the existing dyke and highway. Drag-lines dredged a new path for the channel so the current would flow through the new aboiteau. Then the old aboiteau was plugged.

The MDRC would afterward use drag-lines and bulldozers on all major construction projects and concluded that both types of machine could be used economically. Bulldozers were found to do excellent work on firm soil but proved inefficient on soft ground, where drag-lines working on mats were more economical.¹¹ The MDRC also concluded that much depended on the skill of the machine operator in either case.¹²

The cost of experimenting with machinery, the fact that many repairs had to be done on badly flooded areas, and the shortage of skilled men under 65 all contributed to much higher spending by the MDRC than first expected.¹³ Although

the Federal Government worried about escalating costs, Dr. Archibald echoed many others in his wish to see the Programme continue:

It would appear unwise to drop this project, which would definitely be a waste of public monies, a breach of faith with the marsh owners, and the ruination of large tracts of good marshland and good uplands. The enormous cost of rebuilding highways in new locations and the cost in disruption of transportation by railways if this project is not completed would be a national waste and would bring enormous criticism on governments. . . .¹³

By the end of 1947, the MDRC had administered 80 projects in Nova Scotia and 50 in New Brunswick. The total length of dyke, aboiteaux and drainage canals constructed was 44.4 kilometers.

However, the dykes still continued to deteriorate faster than the 'three-way programme' could repair them, and the pressure for an agency like the Prairie Farm Rehabilitation Administration continued to grow.



Figure 21 The Canning Aboiteau, constructed in 1944-45, nearing completion. The extensive cribwork nearly up to grade is being reinforced with rock. (Photo Nappan Experimental Farm)

Looking back on the 'three-way programme' today, Wilf Byers gives a lot of credit to MDRC Chairman W.W. Baird "for getting the Programme rolling and for creating the right atmosphere for dykeland reclamation on a much wider scale. The man grew up on a good farm and knew what good land could do. He believed the rehabilitation of the dykelands would usher in a whole new era of agriculture in the Maritimes, especially in Cumberland County."

In 1982, Arnold Roberts described the MDRC as "a patch on a patch. The Programme just couldn't handle all that needed to be done. However, we did learn a lot about using machinery on dyking projects. Some of the lessons were very expensive, but there was no way around it. Part of the purpose of the Programme was to experiment and that's what we did."

With dykeland farmers putting pressure on politicians in Halifax and Fredericton, and Agriculture Minister Gardiner and Dr. Archibald carrying on an intense lobby at the federal level, Ottawa and the provinces agreed to attack the problems of the dykelands on a grand scale.¹⁴

In June 1948, Ottawa passed the Maritime Marshlands Rehabilitation Act (MMRA) and signed complementary agreements with Nova Scotia, New Brunswick and Prince Edward Island the following April.

In the next 10 years the Maritime dykelands would face more changes than in any other period of their 350-year history.



Figure 22 The upstream end of the newly completed Canning Aboiteau sluice in 1945. This aboiteau was 3-barrel, each 1 m wide and 1.5 m high with bronze gates and frames. (Photo Nappan Experimental Farm)

Chapter X

The Decade of Salvation

As construction of the Shepody Dam began in the fall of 1953, the battle to reclaim the region's dykelands faced its most critical test. Could modern machinery, working on slippery marsh soil, close the mouth of a major river by a large tidal dam? If so, the struggle against the tides could some day be won. If not, reclamation would continue to be costly and time consuming. Much of it might have to be abandoned . . . !



With the signing of agreements between the Federal Government and each of the Maritime Provinces in 1949, rehabilitation of the dykelands moved quickly into high gear. J.S. Parker, a former administrator of the Prairie Farm Rehabilitation Act, became the Maritime Marshlands Rehabilitation Act's first director. The headquarters of the new agency were set up at Amherst, Nova Scotia, to house its administrative and engineering branches, while district construction offices were established at Moncton, New Brunswick, and Windsor, Nova Scotia.

In comparison with the MDRC, whose two staff members worked out of an office at the Experimental Farm at Nappan, the MMRA had a staff of 75. Most of them were in the engineering branch, which began to carry out investigations in each of the six main divisions.

A *survey and drafting division* started making complete topographical surveys of the areas to be considered for rehabilitation; a *drainage division* started investigating the drainage requirements of potential projects, designing the necessary freshwater drainage systems and determining the size and number of aboiteaux required; a *soil mechanics division* began to analyze foundation and other soil conditions at potential construction sites; a *seeding division*, working with the Experimental Farm Service and the Nova Scotia Department of Agriculture, selected grass mixtures to find the best protective cover for dykes and aboiteaux; a *construction division* prepared to carry out the construction program; and a *workshop division* began to maintain the Administration's fleet of vehicles, earth moving equipment and

allied construction machinery. The workshop division also began prefabricating timber sluices (in sections) and other common construction items.

As the MMRA set out to provide the greatest protection for the smallest cost, Mr. Parker made it clear that organization would not rely on engineering theory alone. He appointed Robert Palmeter, commissioner of the Grand Pré Marsh and an experienced dykeman, as Chief Aboiteau Superintendent, and indicated the agency would seek the advice of other experienced men such as John Woodland, Annapolis County; Alfred Jonah, Albert County, New Brunswick; and Fred Palmeter, Kings County, Nova Scotia; as well as the records of past work kept by clerks such as Ernest Eaton of the Wellington Dyke and Donald Harper, clerk to several New Brunswick marsh bodies.

In an interview during the MMRA's first year, the Director acknowledged the work done by the Emergency Programme. "Much more marshland would have gone out to sea," he said, adding that the experiments carried out on ditching, dyking and aboiteau building by the Experimental Farm at Nappan produced results that were being used by the MMRA."

Looking ahead, the Administration began preliminary surveys for large tidal dams near the mouths of the Shepody, Tantramar and Annapolis rivers and studies of similar works for the Chiganois, Nappan, Petitcodiac, Memramcook and Avon rivers. Such structures would protect thousands of hectares of dykeland and eliminate the need to build or maintain many aboiteaux and miles of dyke upriver.

In 1949 the MMRA phased out the MDRC and launched the first two projects under the new 'rules of the game'. Under the Act, the Government of Canada was responsible for building — or rebuilding — dykes and aboiteau, and for maintaining these protective works. The Federal Government also agreed to provide all required engineering services.

Each Maritime Province had passed a Marshland Reclamation Act to organize dykeland owners into legal marsh bodies where projects were planned; to assemble land necessary for construction projects; to develop and carry out a suitable land use policy; and to provide the dykelands with adequate drainage.

Dykeland owners wishing work done in their areas had to incorporate into a marsh body. This required the signatures of two-thirds of the owners holding at least half of the marshland within the designated area.

A Marshland Reclamation Commission in each province

approved marsh bodies for incorporation and determined which projects should be proposed to the MMRA for action. The proposals would then be considered by the Administration's Advisory Committee for a final decision.

The original members of the Nova Scotia Marshland Reclamation Commission, which met for the first time on July 19, 1949 were:

Angus Banting Chairman	Director of Agricultural Engineering Nova Scotia Department of Agriculture and Marketing, Truro
C.E. (Ted) Henry Secretary	Dykeland Engineer Nova Scotia Department of Agriculture and Marketing, Truro
Walter Lusby Farmer	Amherst, Cumberland County
Thomas Smith Farmer	Hilden, Colchester County
Paul Lawrence Farmer	Falmouth, Hants County
Howard Burbridge Farmer	Canard, Kings County
A.L. Morfee Citizen	Granville Ferry, Annapolis County

The members of the New Brunswick Marshland Reclamation Commission were:

J. Arnold Roberts Chairman	Director of Agricultural Engineering New Brunswick Department of Agriculture, Fredericton
Ronald MacIntyre Secretary	Dykeland Engineer New Brunswick Department of Agriculture, Moncton
Charles A. Trueman Farmer	Point de Bute, Westmorland County
Joseph Gaudet Farmer	Memramcook, Westmorland County
Samuel R. Colpitts Farmer	Colpitts Settlement, Albert County

James L. Anderson Farmer	Middle Sackville, Westmorland County
Frederic A. Stewart Farmer	Albert, Albert County

The first MMRA Advisory Committee appointed in July, 1949, consisted of:

John S. Parker Chairman	Director of MMRA Amherst
W.W. Baird	Superintendent Canada Experimental Farm Nappan, Nova Scotia
Smith Hilton	Director Canada Agricultural Research Station Fredericton, New Brunswick
Angus Banting	Chairman Nova Scotia Marshland Reclamation Commission Truro, Nova Scotia
Walter Lusby	Member Nova Scotia Marshland Reclamation Commission Amherst, Nova Scotia
Aubrey Trenholm	Representative Maritime Federation of Agriculture Fort Lawrence, Nova Scotia
J. Arnold Roberts	Chairman New Brunswick Marshland Reclamation Commission Fredericton, New Brunswick
James F. Anderson	Member New Brunswick Marshland Reclamation Commission Middle Sackville, New Brunswick

Some marsh bodies had been well organized for several years; others needed the help of dykeland engineers, one for each province to meet provincial requirements.² The engineers acted as liaison between dykeland owners and rehabilitation programs.

Once incorporated, marsh bodies would elect an executive committee, which would in turn appoint officers. Under the new legislation in each province — which was in effect simply the latest in a long line of 'marsh acts' — marsh bodies continued to hold powers similar to municipalities. They could:

acquire, hold, use, sell and lease real and personal property; construct, reconstruct, recondition, repair, maintain, conduct and operate works; enter into agreements with the Province or any person for construction, reconstruction, (etc.). . . ; subject to the approval of the Commission, make regulations respecting works and lands within or affecting the Area; raise money for its purposes by the levying of assessments in the manner hereinafter provided; and do and perform all other acts and things incidental or conducive to the attainment of its objects.³

Sometimes two traditional neighbouring marsh bodies incorporated as one unit with a double name, such as the Bishop-Beckwith Marsh Body in Kings County, Nova Scotia.

At the first meeting of the MMRA's Advisory Committee in July, 1949, two marsh bodies which had already been incorporated requested rehabilitation. One of them, Comeau Marsh on the Annapolis River at Moschelle, had an urgent problem. Their 80-year-old main aboiteau, protecting 113 hectares of dykeland, was certain to fail. After detailed investigation, the MMRA Survey Division reported that a new aboiteau should be constructed just upstream from the old one.

Comeau Marsh became the first Nova Scotia body designated for work by the MMRA. It was listed officially as Project N.S. 1. Using their own equipment, the MMRA built the new sluice on the recommended site with sections prefabricated at Amherst. The other marsh body ready to participate in rehabilitation was Upper Dyke Marsh on the Shepody River near Albert, New Brunswick. Although no major construction was necessary, maintenance work was required. The MMRA efforts on that marsh body became Project N.B. 1.

By the end of its first year (March 31, 1950), the new agency had 47 projects on its books. Aside from preliminary surveys on tidal dams, there were 22 marsh areas comprising 5 000 hectares incorporated by the New Brunswick government; 17 marsh bodies comprising just under 3 000 hectares in Nova

Scotia; and one marsh body comprising 100 hectares in Prince Edward Island. The total marshbody territory under incorporation was estimated as forming an integral part of farm units with a total area of 50 000 hectares.⁴ The ambitious program of dykeland rehabilitation was off to an inspiring start.

As the MMRA was getting under way, the Canada Department of Agriculture, in co-operation with Nova Scotia and New Brunswick, conducted an economic study of Maritime dykeland farms. The survey, known as the Haase Report, gives a good review of tidal agriculture around the Bay in 1949-50.

In visiting 700 farms containing dykeland, the report found that a large proportion

had a very limited amount of (cleared) upland suitable for cultivation and, thus, the size of their marshland holdings had an important bearing on the size of their business and of the income that could be realized on the farms. Many of the farms were too small for the operators to have an adequate size of business. These operators generally found part-time employment off the farm. Other farmers developed sufficiently large-scale operations on about 400 acres of marshland and 200 acres of cultivated upland to employ five full-time men.



Figure 23 A typical section of plank-facing installed to protect the sea side of the dyke from erosion due to wave action and tidal currents. This method of protection was used up to the mid-1950s and was superseded by rock rip-rap. (Photo MMRA)

The average size of marsh holdings was 39 acres per farm reporting. . . The farms in the Tantramar area had the largest holding of marsh per farm, 66 acres as compared with only 13.7 acres in the Annapolis River area. . . Only 47 farms included more than 100 acres of marshland.

There is considerable variety in the types of methods of farm organization in the marshland districts. The livestock enterprise is of commercial importance on most farms but is more intensive on farms with milk sale outlets. Some farms, on the other hand, are used mainly to provide their owners with rural residences.⁵

Published in 1953 as *Marshland Utilization in Nova Scotia and New Brunswick*, the report included a healthy sample of farms in most of the major dykeland areas, but did not include the Cobequid dykelands extending from the Truro area, tidal lands along the Petitcodiac, nor many smaller dykeland areas.

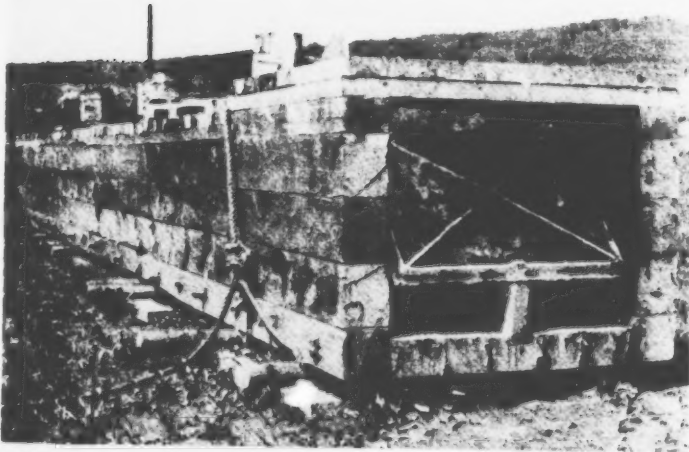


Figure 24 This single-barrel timber sluice with a brass gate was set up beside an excavation for a new aboiteau on Taylor Village Marsh in New Brunswick. When the bed was completed the sluice was pushed into place by bulldozers. Construction took place in 1951. (Photo MMRA)

In the survey, tidal lands 'out to sea' ranged from 9% in the Kentville-Windsor area to 62% in the Amherst-Nappan sample. More than half the dykeland not out to sea was in clover, timothy and other hay, with most of the balance devoted to pasture, broadleaf and oats, and a few scattered acres in mixed grains, roots and vegetables.⁶

Associated upland was also largely under English grasses, but with usually higher percentages than dykeland of mixed grains, oats, roots and vegetables. In the Annapolis Valley as much as a third of the upland might be in apples, though other areas had only a few acres in the crop. Upland associated with dykeland also had a few scattered acres of barley, small fruit and corn.

The report found the links between dykeland and associated upland weakest in the Tantramar area where the distance between them was "so great as to preclude close integration of marsh holding with the remainder of the farm units."⁷

The survey included a profile of several 'model' farms showing what could be done on dykeland soil.

During its third year, 1951-52, the MMRA reclaimed nearly 600 hectares of tidal farmland. Construction totals to date reached 65.6 kilometers of new dyke, 4 328 meters (linear) of new plank facing and 120 aboiteaux. One hundred meters of



Figure 25 When suitable soil conditions existed dykes were successfully and economically constructed with bulldozers. (Photo MMRA)

plank facing had been repaired and over 2 000 meters of the most exposed dyke locations had been protected by brush mats and rock cribs. On many marsh bodies an improved drainage grid, designed by the MMRA, reduced the number of aboteaux.⁸

Through its research and experience to 1952, the new agency stated the three basic factors unique to Maritime dykeland construction as: (1) the great tidal range of the Bay of Fundy; (2) the generally weak structure of soils and underground foundations; and (3) "low working limits from the standpoint of economics"⁹ — that is, costs had to be justified on the basis of agricultural value, although the protection offered to roads and other utilities often figured in the cost-benefit analysis. In its third annual report, the MMRA's engineering branch could describe how these challenges were leading to new approaches on several fronts.

An extract from the MMRA Annual Report, 1952, shows that the following guidelines were adopted for the various construction phases:

(a) *Dykes* — It has been found necessary to construct dykes of a larger cross-section than was originally anticipated. For the most part dykes are constructed with a slope of three to one on the sea side and two to one on the marshland side. As the dykes can be made only with the material on hand, occasions have arisen when the earth used has had a water content of 80 per cent. As a result larger fills of earth are required and it is sometimes necessary to rebuild certain sections after the fill has become partially dried. Due to certain sections of dyke foundation being extremely weak, it is necessary to brush these locations prior to dyke erection. Provision is made through shallow ditches, or by grading, for the proper drainage of freshwater away from any dyke base. The outside borrow pits are made to drain which in turn encourages silt to be deposited from the silt-laden tide water.

(b) *Dyke Protection* — In those locations where dyke is exposed to severe wave action, it is necessary to provide a form of plank facing. The timber used is pre-treated with a solution containing sodium fluoride and dinitrophenol.

Where no special protection is required, an effort is being made to establish salt-tolerant grasses on the sea side of the dyke. Suitable grass mixtures are not readily available. It has been found possible to harvest and reseed native *Maritima Puccinellia*, a semi-salt-tolerant grass, with favourable results. Tall

wheat grass also appears to withstand saltwater flooding to some degree.

As the soil placed in the dykes very often contains large quantities of salt, ground gypsum is applied on the top and the inside slope of the dyke to speed up leaching. Lime is later applied if required. This portion of the dyke is then seeded to grass, a mixture containing timothy, red top, common and Dutch white clover, crested wheat grass, brome grass, western rye grass and meadow fescue. This is an experimental mixture and certain species may be eliminated.

(c) *Aboiteaux* — The pre-fabrication of timber sluices, based on a standard design, continues to be satisfactory. Although brass alloy gates are installed in most structures, cast iron and aluminum alloy substitutes have been installed on an experimental basis with a view to finding a more efficient and less costly gate. A steel gate with a chain suspension to help diminish head losses has been designed. These are pre-fabricated and are treated with a



Figure 26 An aboiteau on the Allain River Marsh in Annapolis County under construction. The timber sluice has been set on its bed and brushing of the aboiteau fill is in progress. Brushing as is shown here is done between every .6 m layer of fill. This work was done under the MMRA Program in the 1950s. (Photo MMRA)

preservative as a protection against corrosion. It is not expected that these gates will have as great a lifetime as those made from brass alloy but they are relatively inexpensive. In certain installations cylindrical pressed fibre pipes, with steel gates, have been used in place of the more conventional timber sluices.

(d) *Bank Protection* — In those locations where the cutting action of the tide erodes the river bank, it is necessary to install a form of breakwater in order that undercutting of the dyke may be prevented. To date, a brush mat appears to be the most satisfactory protective structure. However, in some locations, where the action has been particularly severe, rock crib work has been installed.

(e) *Drainage* — The design and lay-out of freshwater drainage systems for all marsh areas is carried out as a service to the two provinces. Standard specifications have been developed and are employed.

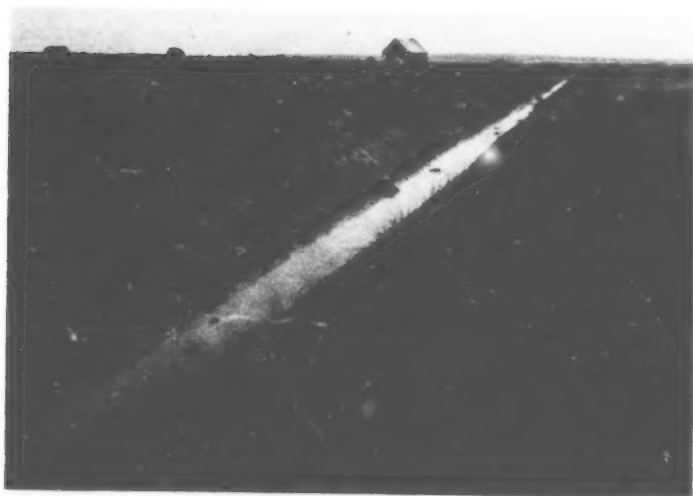


Figure 27 To provide for land improvement, large drainage ditches were required. This photograph shows a main drainage ditch excavated by a drag line. This ditch is approximately 1.2 m deep and 0.9 m wide at the bottom, with 1:1 side slopes. (Photo MMRA)



Figure 28 Applying hand-cut saltmarsh sods to a machine-built dyke to prevent erosion damage. (Photo MMRA)

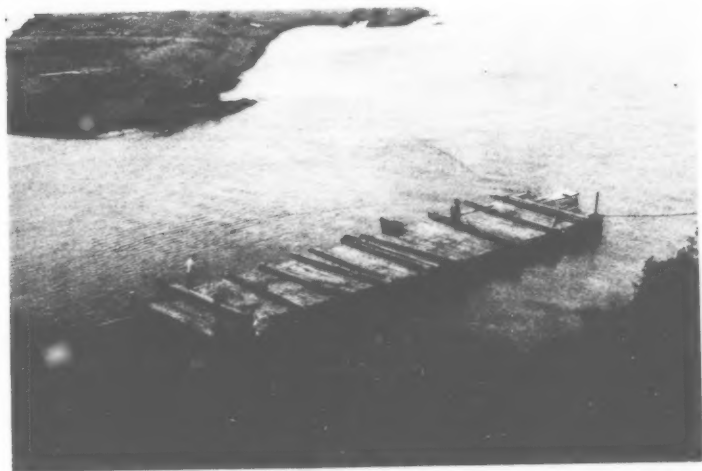


Figure 29 Floating an aboiteau sluice into position on St. Martins Marsh in New Brunswick. When the tide recedes the sluice will come to rest on a prepared bed. It must then be anchored in place so it will not float out of position on the next tide. (Photo MMRA)

The third year included one radical departure from the traditional materials used in aboiteau construction in the Bay of Fundy area. An aboiteau at Truro Dykeland Park was built with a concrete sluice and rock-and-earth fill. No brush mats were used to strengthen the foundation or bind the fill.¹⁰

The new materials were used because the soil contained large amounts of gravel and could support the weight of an aboiteau without the brush necessary to 'brace' an aboiteau on weaker, more slippery soil.

Yet another development during the Administration's third year was its first project involving a joint approach with another government agency. The MMRA combined with the New Brunswick Department of Highways and Public Works to build an aboiteau in Westmorland County that would also serve as a highway bridge.

Although reclamation proceeded at a fast pace during the first three years, there was occasionally a feeling that more could have been done if the large program had begun earlier. In December, 1951, Director Parker was happy to announce that 300 of more than the 700 hectares 'out to sea' on the John Lusby Marsh Body near Amherst had once again been reclaimed. "However," he said, "the entire marsh could have been brought back if the work had begun several years earlier." By 1950 the tide had created gullies 12 to 15 meters deep and 30 meters wide on the outer part of the marsh, making reclamation of that area impossible.

The protection provided by the MMRA was coming at a comparatively low price. In 1953, the amount spent on reclaiming the dykeland per year was estimated as equal to the amount spent on sixteen kilometers of contemporary four-lane highway.¹²

Reclamation of some dykeland was not considered worth the cost when the work was physically possible. For instance, during the Administration's third year, its Advisory Committee

recommended that only necessary minor maintenance be undertaken on the existing protective works at Wood Point (Westmorland County) and that if and when such works collapsed the marsh area be allowed to remain out to sea. . . The decision of the Committee was reached after consideration of the high initial cost of works compared to the benefits derived from the marsh. It was pointed out at the meeting that the dyke was very vulnerable and that many of the Wood Point marsh owners also owned land on a neighbouring protected marsh (Westcock), which had the capacity



Figure 30 Rock rip-rap being applied to the seaside of a dyke to control erosion from wave action. This method generally replaced the traditional plank-facing used prior to the mid 1950s. (Photo MMRA)

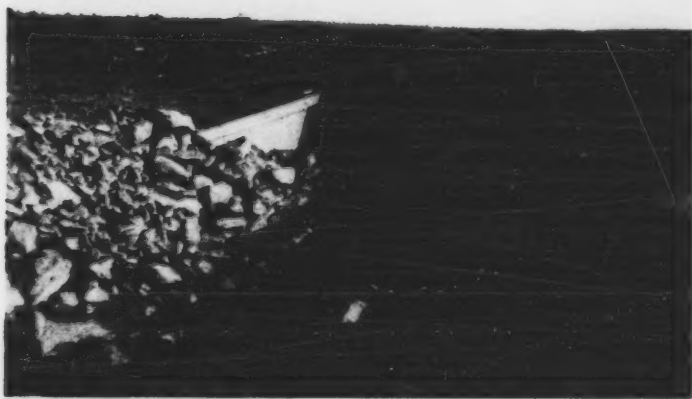


Figure 31 A typical aboiteau, constructed by the MMRA in the 1950s on the River Hebert Marsb, discharging freshwater at low tide. It is of timber construction with a two-barrel sluice and has bronze gates.

to satisfy the requirements of its owners if properly utilized.¹³

† Tidal Dams

The MMRA launched what could be called its second phase in the fall of 1953 when work began on a large dam near the mouth of the Shepody River at Harvey Bank which would protect 2 200 hectares of dykeland from tidal flooding (including 600 then out to sea). Instead of the conventional aboiteau sluice, 4.87 m x 6.09 m (16" x 20") steel gates would move up and down between large concrete piers 15 meters high. The gates would be raised electrically by a hand-operated switch only when freshwater run-off might create flood levels above the dam.

† Construction of the Shepody Dam

The method of construction used for the Shepody Dam set the pattern for building the tidal dams that followed.

Working behind coffer dams on the east side of the river, in addition to the permanent water control structure, a large concrete by-pass waterway was also constructed. This waterway was divided into bays with the erection of concrete pillars that would accommodate stop-logs. The original river channel was then closed as much as possible by dumping fill to dam the channel. At this point the coffer dams at the water control structure were removed and the river allowed to flow through the by-pass sluice, thus relieving the pressure on the river channel being closed. After stock-piling adequate fill to close the remaining gap in the river channel, at appropriate tide conditions the river was closed in the time between one high tide and the next high tide.

Then the by-pass spillway was closed dramatically by dropping stop-logs simultaneously in each of the bays of the by-pass. This was accomplished through the use of explosively activated locks holding the logs in a raised position. The by-pass spillway was then covered by earth fill and became part of the roadway along the top of the dam.

Built under the direction of resident engineer Doug Carter, the Shepody Dam is 427 meters long, over 15 meters high (four meters above maximum tide) and connects five kilometers of 2.5-meter dyke on both sides of the river. For most of its width the dam is made of rock fill, with a width across the top of nine meters. The maximum width of the base is 58 meters and at its deepest point the fill is 17 meters, top to bottom.



Figure 32 A timber aboiteau under construction on Minudie Marsh in the 1950s. Note the brush mats on the sides of the excavation and the drag-line placing the back-fill over the sluice.

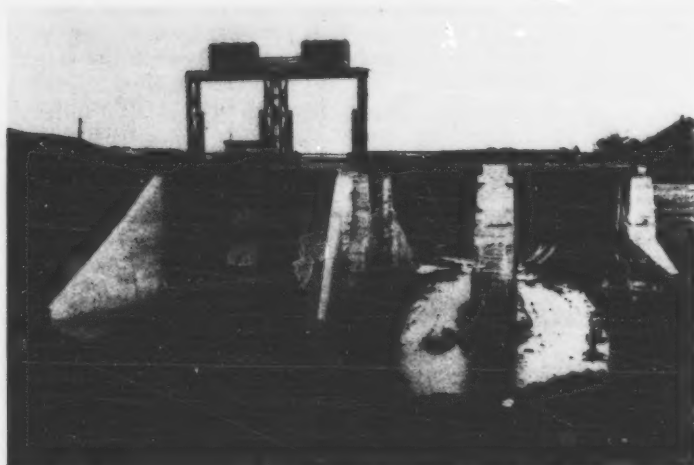


Figure 33 The Shepody River Dam nearing completion in October 1955. This was the first of a number of large structures constructed to protect large blocks of dykeland from saltwater flooding. The permanent discharge gates are on the left with temporary by-pass sluices on the right. (Photo MMRA)

The Shepody Dam came 'on stream' after two and a half years of construction, ending all maintenance and replacement of protective works above the structure and proving that large tidal closures were possible. Plans to build similar dams on the Tantramar and Annapolis rivers could proceed with confidence. The end of the dykeland crisis was in sight.

Meanwhile, the number of MMRA projects reached 151, involving nearly 27 000 hectares of dykeland and 648 hectares of salt or unprotected marsh. By the end of its seventh year the agency had built or reconstructed 327 aboiteaux and eliminated another 370; built 225 kilometers of new dyke and strengthened an additional 95 kilometers; installed or repaired 25 kilometers of plank or rock dyke facing; installed 13 breakwaters; and seeded 220 kilometers of dyke.

The crowning achievement of the MMRA's first decade was construction of the Annapolis River Dam, which got underway in March, 1958. The dam, which now protects 1 740 hectares of dykeland, was built across the narrows at Annapolis Royal just above a failing highway bridge and below many deteriorating dykes and aboiteaux along the river to tidehead, 25 kilometers upstream. The construction method for the 366-meter-long dam — possibly built within a few meters of the first Acadian dykes — followed the pattern used for the Shepody Dam.



Figure 34 Closing the Shepody River Dam in 1955. Always a difficult task as closure must be accomplished between successive tides. (Photo MMRA)

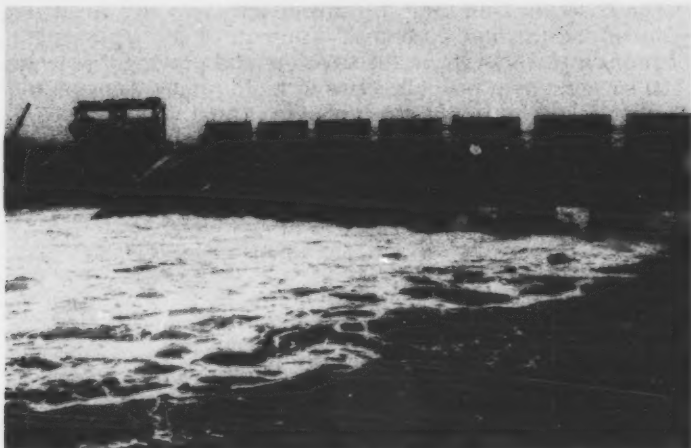


Figure 35 The Annapolis River Dam, Annapolis, Nova Scotia. The causeway, located to the left of the picture, has diverted all river flow to this area. On the left side of the picture are the control gates in a raised position. The right side shows the by-pass sluices with the stop-logs in place ready to be dropped. This photograph was taken in 1960. (Photo MMRA)



Figure 36 The Annapolis River Dam with the stop-logs dropped in place and the control gates in a lowered position. The by-pass sluices are being covered with rock fill and will become the approach road on the south end of the dam. The control gates are now part of the tidal power system. (Photo MMRA, July 1960)

According to D.C. Milligan, Chief Engineer for the Nova Scotia Department of Agriculture and Marketing, chairman of the Nova Scotia Marshland Reclamation Commission and a member of the MMRA Advisory Committee, "We kept patching dykes and aboiteaux along the Annapolis River while the dam went up. Completion of the dam in the summer of 1960 signalled that all projects in the region had been brought under control and we could breathe a little more easily."

Contributing to the sense of relief was the Tantramar River Dam, completed earlier in 1960. Built a short distance upstream from the CNR bridge and near the upland at Sackville, New Brunswick, the dam complemented the CNR roadbed and the Etter aboiteau in protecting more than 7 000 hectares of dykeland. The dam also allowed improved drainage for the traditionally swampy upper reaches of the Tantramar Marshes and provided a river crossing for the Trans Canada Highway, replacing a timber bridge.

The Advisory Committee did not meet in 1961-62 because there were not new projects to consider.

By 1966 practically all the tidal lands in the Maritimes that had been recommended for reclamation had been protected from the tide. The only remaining major construction projects still on the books were a major tidal dam on the Petitcodiac at Moncton, already underway, and a causeway across the Avon River at Windsor.

The same year, Ottawa startled some Maritime officials by announcing its intention to transfer the responsibility for dykeland protection to the provinces by 1970. When the Maritime Marshland Rehabilitation Act was passed in 1948, it carried the standard clause about turning Ottawa's responsibilities over to the provinces at the federal minister's discretion. However, most people involved in dykeland reclamation and maintenance in the Maritimes assumed that the agreement would be as open-ended as the Prairies Farm Rehabilitation Act, which still survives in the West.¹⁴

The tidal dam on the Petitcodiac, completed in 1968, protects 595 hectares of dykeland and serves as a highway crossing. The Avon River project, finished in 1971, would keep the tide off 1 315 hectares of dykeland and allow highway and railway crossings over the river. The structure would also provide a freshwater head-pond adjacent to the town of Windsor.

At the 'changing of the guard' in 1970, the MMRA had 115 active projects (28 in New Brunswick, 86 in Nova Scotia and one in Prince Edward Island). The total area of dykeland

protected was 33 275 hectares.

The 20-year war to save the region's most fertile soil had been won. Yet the challenge of preserving the victory, and of using this rich farmland to its full potential, continued.



Figure 37 Constructing a dyke with drag-lines at South Maitland, Nova Scotia, in 1970.



Figure 38 This photograph shows the concerted effort that was required to close the Avon River Causeway at Windsor, Nova Scotia, on June 12, 1970. This was the second attempt at closure that required nine of the largest bulldozers available working non-stop between tides.

Chapter XI

Problems and Potentials



Since 1970 all government activities and programs related to the Fundy dykelands have been conducted by the Nova Scotia Department of Agriculture and Marketing and the New Brunswick Department of Agriculture and Rural Development, supplemented by assistance from consulting firms and the Maritime Resource Management Service (MRMS) at Amherst, which houses the records and remaining technical personnel of the MMRA.

The protective works around the Bay of Fundy are patrolled and maintained largely by district aboiteau superintendents (five in Nova Scotia; two in New Brunswick). In both provinces these officials report to the Dykeland Engineer in their respective departments of agriculture.

Although engineering advances have continued in the construction of dykes, aboiteaux and other protective works, emphasis has shifted to problems of drainage and land use. One of the major aims of the Nova Scotia and New Brunswick governments has been to help to increase the amount of dykeland that can be farmed with modern machinery. Small holdings have been assembled into larger, more efficient blocks, a process that has been greatly assisted by the adoption of a drainage method commonly referred to as land-forming or crowning. The land-forming system differs little from the traditional system of flats or dales and ditches, except that the area worked between ditches is generally much larger and the ditches and water-ways are not so pronounced. Frequently drains are constructed more in the nature of a grassed water-way, so that machines can cross the

watercourse without doing any damage to the water-way or machine.¹

In Nova Scotia, dykeland is undergoing land-forming at the rate of 600 to 800 hectares a year. Twenty-five per cent of the total area has not been "crowned".

Today the 33,000 hectares of dykeland in the Maritime provinces produce hay, corn, some grain and a small but increasing harvest of roots and vegetables. Yet surprisingly, much dykeland is used sparingly or not at all. A major reason is that the market for many of its products is already saturated. Except for the dairy farm, producers have had to contend with imports of cheaper foods outside the region. While dairy farmers, with the only reliable cash crop, have had money to invest in maintaining and improving their dykeland, other operators have little such incentive or opportunity.

Other reasons given for the under-utilization of dykeland are the shift of traditional farm labour to jobs in the cities and at large Canadian Forces bases built in the Fundy area after World War II, and the fact that much dykeland is too far from urban centres to allow part-time farming.²

Yet the situation is not permanent. Continued increases in transportation costs for imported food, changes in trade tariffs, a large increase in the region's population due to off-shore oil development — or some other factor — could bring all available dykeland into production.

Some dykeland owners are not waiting for change, but are testing the market for alternative crops such as peas and beans. Others are producing grass meal as a food component for poultry, hogs and cattle.

J.D. Hilchey, Supervisor of Land Use Programs for the Nova Scotia Department of Agriculture and Marketing, believes the key to realizing the full potential of the region's dykeland lies in large-scale federal-provincial aid in drainage, high taxes on unused tidal farmland and the sale of idle dykeland to active farmers.³

Meanwhile, respect for the potential of dykeland farming has continued to grow. Dykeland has been called a reserve of energy in the form of fertility.⁴ As the cost of fertilizers needed for upland farming continues to rise, the value of the same nutrients already in the tidal soil increases as well. In the future, some farm operators may raise their efficiency by moving the site of some of their production from upland to dykeland. Recent sales of dykeland for as much as (\$2500.00/hectare, \$1,000.00/acre) reflect the present and

future value of tidal farmland to the agricultural community.

Although some dykeland is lying idle, certain areas of tidal land near urban centres have been used as sites for shopping centres and houses. While some towns around the Bay of Fundy have building codes that prohibit such construction, municipal governments for areas outside city limits have no such rules.

Provincial governments are concerned because dykes were built to protect agricultural land, which can stand an occasional soaking. Unfortunately, many people who live or work on tidal land do not realize that they are on ground that has historically been flooded by saltwater several hours a day. Others are aware of the dykes but feel they offer absolute protection.

In the Truro area, for instance, where many businesses have been built on the tidal plain, the dykes have been built high enough to keep out the average highest spring tides. Higher tides, naturally, flood basements and ground floors of the 'dykeland buildings'. However, if the dykes were made any higher, they would trap freshwater springtime runoff and worsen flooding along the Salmon and North rivers.

However, an occasional low-level soaking is not the worst problem that tidal-plain buildings could face. An official with the Nova Scotia Department of Agriculture and Marketing has listed a combination of factors that cause flooding on the dykeland in the Truro area: a dry fall, causing drainage channels to silt up for lack of rapidly running water; a cold January, causing ice build-up on the downstream end of aboiteaux and preventing freshwater drainage; and a very warm, rainy February, creating large runoffs into the Salmon and North rivers.⁵

† Rising Sea Level

In a related long-term problem the area that can potentially be flooded by the tides is getting larger, as the level of Fundy waters continues to rise about 40 centimeters per century in relation to the land.⁶ This trend does not cause any problems in keeping dykes at an appropriate height. However, in relatively flat areas, a change of a few centimeters in tide levels could extend the potential reach of saltwater hundreds of meters inland, causing flooding in areas not currently thought to be on the tidal plain.

† Ecological Effects of Dyking

Dyking has been so extensive around the Bay of Fundy that

some people feel the marine food chain may have been disrupted. However, the report of a recent series of conferences set up to study saltmarshes in Nova Scotia concluded "the high marsh nature of the reclaimed lands" and "the general low density of marine invertebrates in these marshes" has meant that Fundy dyking "probably involved relatively little interference in marine food chains."⁷

Many hectares of swampy saltmarsh around the Bay, too difficult to protect and drain for agriculture, have been turned over to Ducks Unlimited, which administers such areas as wildfowl preserves — and which builds dykes to keep freshwater *in*.

† Conclusion

Although the Acadians of the seventeenth and eighteenth centuries made intensive use of the several thousand hectares of dykeland they reclaimed, the full agricultural potential of the Fundy tidal lands is only now ready to be achieved.

The dykelands are universally well protected; land-forming and the trend to larger units is making the land accessible to modern machinery; and an understanding of the potential of dykeland soil continues to grow.

It is only a matter of time before changes in markets, population, fuel costs, regulations — or some unforeseen crisis — lead the region to turn to the dykelands for the riches they stand ready to provide.

Chapter XII

Current Trends in Dyke and Aboiteau Construction



xcept for modern tidal dams, seventeenth century Acadian dyke builders would surely recognize today's dykes and aboiteaux as larger versions of the protective works of their own period. However, dykes have become larger and more gently sloped; rock has replaced sods and planking as dyke facing; and concrete, plastics and steel have replaced logs and timbers as sluice and sluice-gate construction materials.

† Dykes

The traditional method of using nearby marsh soil as fill has continued. The newest added material is a coarse woven synthetic fabric (much like carpet backing) which has been on trial for several years. Used to strengthen the foundation soil and to help prevent erosion on the dyke face, the material has an open weave which, it is hoped, will allow for plant growth.

The current most common material for dyke facing on the sea side is rock, which was first tried in the early days of the Emergency Programme to reinforce planking and became standard practice by 1960. The great advantage of rock is that it can be easily moved and used. A truck can bring loads of rock from a quarry and dump it over the sides of a dyke.

Although facing with rock is the method generally used to give protection to the dykes from wave action, the top and inside slopes also require protection from over-topping by tide and from rainfall. The most feasible method to accomplish this is to provide a strong grass cover. However, with the use of salt-saturated soils to construct the dykes, a grass cover is

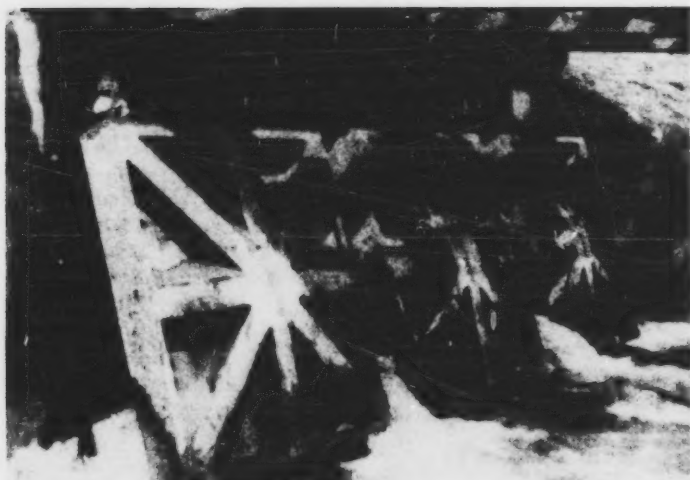


Figure 39 During the MMRA program, steel aboiteau gates suspended on cable or chain binges replaced the brass or bronze gates on solid binges. This change applied particularly to moderate to large gates. (Photo MMRA)



Figure 40 Shown are two 46-m lengths of polyethylene pipe each 1.2 m in diameter that were used to repair the Noel Shore Marsh aboiteau in 1982. This pipe was pulled through the existing square-barrelled timber sluice. The voids between the outside of the pipe and the timber were then pumped full of concrete grout.

difficult to acquire. To increase the rate of leaching the salt from the surface of the dykes, gypsum was sometimes used. This had the effect of causing the soil particles to flocculate and allowed water to penetrate the surface of the soil and flush out the salt. This increased the rate at which good grass covers were established. Once established, the dyke cover is kept thick and healthy by annual mowing, and fertilizing when necessary.

† Aboiteaux

Traditionally, aboiteau fill has been made of alternate layers of staked brush and earth fill. However, since about 1960, the fill has been an impervious core of clay supported on both sides by rock facing.

Although 90% of sluices now in use in the region are made of timber, concrete and steel have been used for the last 30 years. Steel pipe has been used for sluices on smaller aboiteaux for replacing falling timber sluices. Round pipe can be threaded through the *worn-out* square sluice and the resulting air spaces filled with *grout* or mortar. On larger projects the sluices are made of concrete and are built over-size to allow for a plastic or fiber-glass lining. An all-fiber-glass sluice with a wall of about an inch (2.5 cm) thick is being used on an experimental basis in Cumberland County; and the Nova Scotia Department of Agriculture and Marketing is working with a major petrochemical company to develop a plastic material for making sluices that are resistant to corrosion, abrasion and impact.

Where the soil is unstable, the traditional method of placing a sluice in an excavated channel, then covering it with brush and fill has been replaced by the more direct method of tunnelling through the fill, usually marsh soil, once it is in place. In the most recent development, a steel sluice is built out of tunnel liner plates (approx. 46 cm x 90 cm), which are bolted on one at a time from inside as the hole for the sluice is excavated.

Meanwhile, timber sluices have to be maintained. Although the unexposed part of a timber sluice may last as long as 75 years, the exposed areas need to be replaced every 20 to 25 years. The galvanized steel spikes that are meant to hold the timbers together wear out faster than the wood, and there always seems to be a least one bad piece of timber in a wooden sluice.¹

Causes of timber sluice failure include damage to supporting members caused by ice as it bangs its way through the



Figure 41 This photo shows a 8 415-m³ excavation that was dug in 1975 in which an aboiteau sluice to service the Wellington Marsh at Canard, Nova Scotia, was constructed. The sluice, resting on 205 timber piles, is 3-barrel, each 1.22 m x 1.52 m reinforced concrete 59 m long.

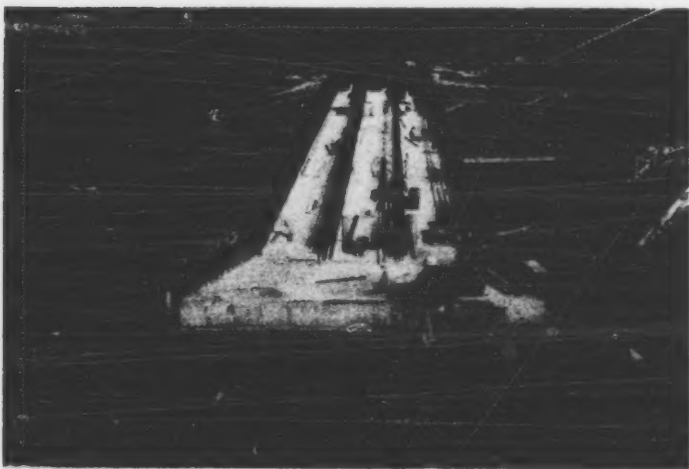


Figure 42 The Wellington Marsh Aboiteau sluice under construction in 1975. The concrete floor is completed. The reinforcing steel is in place for the sluice walls.

waterway; leaks in the fill along the outside of the sluice; weakening of timbers by sea worms; and breaks or cracks in the sluice caused by an uneven settling of the marsh-mud foundation.

The traditional sluice gate was made of wooden plank, reinforced with an iron frame and turned on bearings in sockets inside the downstream end of the sluice. In the 1940s and 1950s bronze gates were introduced to withstand salt erosion; but they were in turn replaced in the late 1950s by steel gates which close over the downstream end of the sluice. After experiments with various types of hinge supports for the steel gates, chains or steel cable were chosen because they allow enough 'play' for anything caught in the opening to work its way loose. Stiffer supports would trap a log, say, between the gate and the opening, leaving the gate open when the tide came in.

For centuries sluices were supported by a foundation of brush and fill. However, the current practice is to use a platform made of piles driven down to bedrock. In some places the bedrock is so far down (more than 15 meters) that the piles must rely on the 'skin friction' between marsh soil and itself for bearing strength.

Other features of aboiteau construction that have evolved since earliest times include the spillway and wingwalls.

An early problem with aboiteaux was that the fill just under the downstream end of the sluice could be eroded by the action of freshwater as it 'doubled back' under the exposed lip of the sluice. If the process went on long enough, so much fill would wash away that the sluice would collapse for lack of support. To solve the problem, a flat wooden floor was built out beyond the downstream opening of the sluice to absorb the force of the draining fresh water.

Wingwalls were built to counter erosion of the fill caused by the scouring action of the tidal currents and ice as it swirled against the downstream base of the aboiteau when the tide came in. Wingwalls also prevented the erosion of fill around the sides of the sluice opening caused by draining freshwater in much the same way that spillways prevented erosion underneath. The angle of today's heavy wooden or concrete wingwalls prevents ice build-up around the downstream mouth of the sluice.

The modern trend in construction is to avoid dealing with running water if at all possible. New dykes are built behind old ones; aboiteaux are built 'in the dry'.

Manual work and animal power have, of course, been

largely replaced by trucks, bulldozers and drag-lines. Small bulldozers have been found better for most projects than large ones because the bigger machines vibrate the marsh soil so much that it begins to act somewhat like a jelly — not the best conditions for construction. Other modern equipment on the dykelands includes pumps, compressors and power tools run by portable generators.

Yet even with the aid of up-to-date technology, the unpredictability of slippery marsh mud and the wide variety of conditions from site to site make every construction project on the dykelands a challenging, if not frustrating, experience.



Figure 43 The erection of a sheet-steel pile coffer dam in which the new sluice for the Canning Aboiteau was built in 1978. Extremely unstable soil conditions required these elaborate preparations in order to set the sluice at the required depth.

The construction of a new aboiteau on the Habitant River near Canning showed what kinds of headaches marsh soil continue to give dykeland engineers.

The old aboiteau had been built by the Emergency Programme 1944. Later the MMRA extended the wooden sluice with steel pipe in order to widen the highway running across the top of it. However, in the fall of 1977 the structure was wearing out. Rather than wait for a crisis to develop, provincial dykeland engineers decided to build a new aboiteau while the old one could give them enough protection to do a proper job.



Figure 44 This photograph shows the Canning Aboiteau under construction in 1978. Timber piles are being driven inside the coffer dam to support the 3-barrel, 1.3 m x 1.6 m sluice. Note the number and size of cross-braces that were required to support the walls against lateral soil pressure.

The first site chosen, on the south side of the river, proved impossible to excavate. As mud came out of the pit, the bottom of the excavation kept coming up, while the ground surface kept sinking nearby. It was an impossible situation and the site was abandoned.

The next year on a new site on the opposite side of the river a sheet steel piling coffer dam was constructed. The coffer dam was large enough to enclose the entire new water control sluice. It was approximately 75 meters long, 10 meters wide, and was made from 10-meter interlocking steel piling. The plan was to excavate the soil inside the dam and, as this proceeded, cross-bracing would be installed to withstand the lateral soil pressures. When the excavation was completed, a layer of coarse gravel was laid, wooden foundation piles were driven, and the concrete sluice, spill-ways and wingwalls were completed. The excavation was then back-filled to the original ground elevation and the sheet piling was extracted. The next step was to open a new channel to direct the river flow through the new aboiteau to permit the old river channel to be dammed.

The project had numerous surprises: unexpected high lateral soil pressure, embankment slips, and leaks. After allowing the structure to sit over winter, the tide was allowed against it in the spring. It was discovered that the extremely plastic soil that had exerted the high pressures on the coffer dam had not sealed the slot that was created when the steel piling was withdrawn. Pumping concrete grout into these sections solved this problem, and the project was completed.

NOTES

CHAPTER I

1. Con Desplanque, engineer, Maritime Resource Management Services, Amherst, Nova Scotia.
2. Howard Trueman (whose family has worked dykeland at Point de Bute, N.B., since the late 1700s) and many others.
3. Results related in 'The Agricultural Future of Dyked Land in Nova Scotia,' by J.D. Hilchey (Supervisor of Land Use Programmes for the Nova Scotia Department of Agriculture and Marketing) in *Saltmarshes in Nova Scotia*, Dalhousie University, Halifax (1981), p. 49. The sample included chemical analyses of 27 dykeland and 33 upland six-inch layers.

CHAPTER III

1. In Marc Lescarbot, *History of New France*, 2, p. 266, quoted in Clark's *Acadia* (See footnote #3, below).
2. Lescarbot, *History of New France*, 3, p. 247, quoted in Clark's *Acadia* (See footnote #3, below).
3. Andrew Hill Clark, *Acadia: The Geography of Early Nova Scotia to 1760*. University of Wisconsin Press, Madison (1968), p. 86.
4. Champlain, in describing the search for a site for their habitation describes "a point which is a league and a half up the river. . . which place could easily be cleared and put under tillage, although the soil is poor and sandy." Quoted in J. Alphonse Deveau's collection of Acadian historical material gathered for the Nova Scotia Museum, (1981), p. 5 (see Bibliography).
5. Clark, op. cit., see p. 83.
6. Clark, op. cit., see pp. 94-5.
7. Clark, op. cit., see pp. 88-9.
8. Nicholas Denys, presumably from *The Description and Natural History of the Coasts of North America (Acadia)*, translated and edited by W.F. Ganong, Champlain Society publications, 2, Toronto (1908). Quoted in Clark's *Acadia*, p. 95.
9. Clark's *Acadia*. Discussed pp. 92, 95, 98.

CHAPTER IV

1. John Erskine, 'Along the Dikes,' *In Forest and Field with John Erskine*, Nova Scotia Museum, Halifax (1971), p. 21.
2. Carl Schott, *The Canadian Marshlands*, University of Kiel (1955). Schott says Dutch engineers supervised extensive marshland operations in the districts of La Rochelle, Saintonge and Poitou under Louis XIII, p. 30 of an unpublished translation by J.W. Byers. Other sources find it difficult to pinpoint the extent or time of this activity in relation to the farmers who emigrated to Acadia.
3. A saltmarsh often slopes *downward* from the low-tide line to the upland because the tide drops its largest particles first.
4. J. Lynton Martin, 'Acadian Farming, 1604-1755', in *A History of*

Everyday Things in Nova Scotia. Nova Scotia Museum. Included in Deveau's collection (see Bibliography).

5. Thomas Respin and John Robinson, *A Journey Through Nova Scotia* (1774). Included in Deveau's collection (see Bibliography).
6. Dr. Barry Moody, Department of History, Acadian University, Wolfville, Nova Scotia.
7. From a document 'Mémoires généraux' AC C11D-2 (1), pp. 93-134 (1686), which Clark says is "usually ascribed to Jacques Demeulle." See *Acadian*, p. 142-3.
8. Clark, *op. cit.*, see p. 149.
9. A. Calneck, *History of the County of Annapolis* (1897) edited and supplemented by A.W. Savary (1933), p. 105. The official was Paul Mascarene.

CHAPTER V

1. This section is largely from *Dikeland Drainage and Land Forming*, T.M. MacIntyre and L.P. Jackson, Agriculture Canada, Nappan, Nova Scotia (1975), p. 2.

CHAPTER VI

1. Letter from the President of the Nova Scotia Council to the British Lords of Trade (December 1760), quoted in A.W.H. Eaton, *The History of Kings County*, Salem Press Company, Salem, Mass. (1910), pp. 184-5.
Eaton, *History of Kings County*, p. 186.
3. Graeme Wynn, 'Late Eighteenth-Century Agriculture on the Bay of Fundy Marshlands', *Acadiensis* (Canada), (1979) 8(2), pp. 80-9.
4. T.C. Haliburton, *An Historical and Statistical Account of Nova Scotia*, 2 Vols., Joseph Howe, Halifax (1829), Vol. II.
5. Haliburton, *op. cit.*, II, 370.
6. Haliburton, *op. cit.*, II, 362.
7. From a document 'Mémoires généraux' AC C11D-2 (1), pp. 93-134 (1686), which Clark says is "usually ascribed to Jacques Demeulle." See *Acadian*, p. 142-3.
8. Clark, *op. cit.*, see p. 149.
9. A. Calneck, *History of the County of Annapolis* (1897) edited and supplemented by A.W. Savary (1933), p. 105. The official was Paul Mascarene.
10. J. Lynton Martin, Director, Nova Scotia Museum, Halifax.
11. Haliburton, *op. cit.*, II, 367.
12. Haliburton, *op. cit.*, II, 367.
13. E.L. Eaton, 'The Dyke Lands', *Nova Scotia Historical Quarterly* (December, 1980), p. 203.
14. Alexander Monro, *History of New Brunswick* (1855), p. 216-17.
15. Monro, *ibid.*, p. 216-17.
16. This section is based largely on Eaton, 'The Dyke Lands', and an interview with Gerald Ayer of Sackville, New Brunswick, a farmer of the nearby Long Lake Marsh Body.
17. W.W. Baird, *Report on Dykeland Reclamation, 1913 to 1952*. Experimental Farm Service, Canada Department of Agriculture,

- Nappan, Nova Scotia, p. 2.
18. The number of motor vehicles in Canada climbed from 535 in 1904 to over 650,000 in 1924. The number of horses fell from 3.8 million in 1921 to 1.9 million in 1948. Gathered from Canada Year Books, quoted in *Marsbland Utilization* (see Chapter VII, footnote 5), p. 56.
 19. Baird, op. cit., p. 23.
 20. J.D. Hilchey, "Agricultural Future of Dyked Land . . .", p. 46; and others (see Bibliography).
 21. *Nova Scotian*, March 9, 1825.

CHAPTER VII

1. E.L. Eaton, op. cit., p. 203.
2. E.L. Eaton, op. cit., p. 204.
3. Howard Trueman, *The Cbignecto Istbmus*, William Briggs, Toronto (1902), p. 103-4.
4. Trueman, op. cit., p. 139.
5. Trueman, op. cit., p. 103-4.

CHAPTER VIII

1. Shirley B. Elliott compiled the press reports in "The Saxby Gale," *Nova Scotian* a XXXIV, Journal of Education, Department of Education, Halifax (October, 1961).

CHAPTER IX

1. Letter to Rt. Hon. J.L. Illsley, Federal Minister of Finance, Hon. A.S. MacMillan, Premier of Nova Scotia and Kings County Municipal Council (April, 1945). A copy supplied by E.L. Eaton.
2. Paul Brown, "A Lesson in 'Bureaucratic Persistence': The Provision of Rehabilitation of Resource Management Services in the Maritimes, 1943-81." Prepared for submission to the *CPA Journal* (December, 1981). Manuscript, p. 5.
3. Brown, *Ibid.*, p. 4. Reference: Letter from Hon. James Gardiner to Hon. A.S. MacMillan, Premier of Nova Scotia (August 14, 1943).
4. Brown, *ibid.*, p. 4.
5. Baird, op. cit., p. 6.
6. *Ibid.*
7. Interview (January, 1982).
8. *Ibid.*
9. Interview with Arnold Roberts (January, 1982).
10. Correspondence with J.W. Byers (April, 1982).
11. Baird, op. cit., p. 12.
12. *Ibid.*
13. *Ibid.*
14. Brown, op. cit., p. 8.
15. *Ibid.*, pp. 4-7.

CHAPTER X

1. *Family Herald and Weekly Star* (March 22, 1950).

2. C.E. Henry for Nova Scotia and Arnold Roberts for New Brunswick.
3. Marshland Reclamation Act (New Brunswick) George VI, (1951) Chapter 183, Section 14.
4. *1st Annual Report of the MMRA*, Canada Department of Agriculture, Amherst, Nova Scotia (1950), p. 7.
5. G. Haase and D.J. Packman, *Marshland Utilization in Nova Scotia and New Brunswick*. Economics Division, Marketing Service, Canada Department of Agriculture in co-operation with the Nova Scotia and New Brunswick Departments of Agriculture, Ottawa (1953), pp. 5-7.
6. Haase and Packman, *ibid.* This is a summary of several pages of detailed statistics.
7. Haase and Packman, *ibid.*, p. 27.
8. *3rd Annual Report of the MMRA* (1962), p. 1.
9. *3rd Annual Report of the MMRA*, pp. 2-3.
10. *3rd Annual Report of the MMRA*, p. 9.
11. *Amherst Daily News* (December 15, 1951).
12. *Family Herald and Weekly Star* (November 5, 1953).
13. *5th Annual Report of the MMRA*, p. 3.
14. D.C. Milligan, Chief Engineer, Nova Scotia Department of Agriculture and Marketing. See also, Brown, *op. cit.*, p. 7.

CHAPTER XI

1. MacIntyre and Jackson, *op. cit.*, p. 13.
2. Arnold Banks, Engineer, New Brunswick Department of Agriculture and Rural Development, plus others.
3. J.D. Hilchey, *op. cit.*, p. 50-51.
4. D.C. Milligan.
5. *Ibid.*
6. Con Desplanque.
7. Opinion of a 'majority of panelists' who met in seminars to produce *Saltmarshes in Nova Scotia*, p. 68.

CHAPTER XII

1. D.C. Milligan.

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